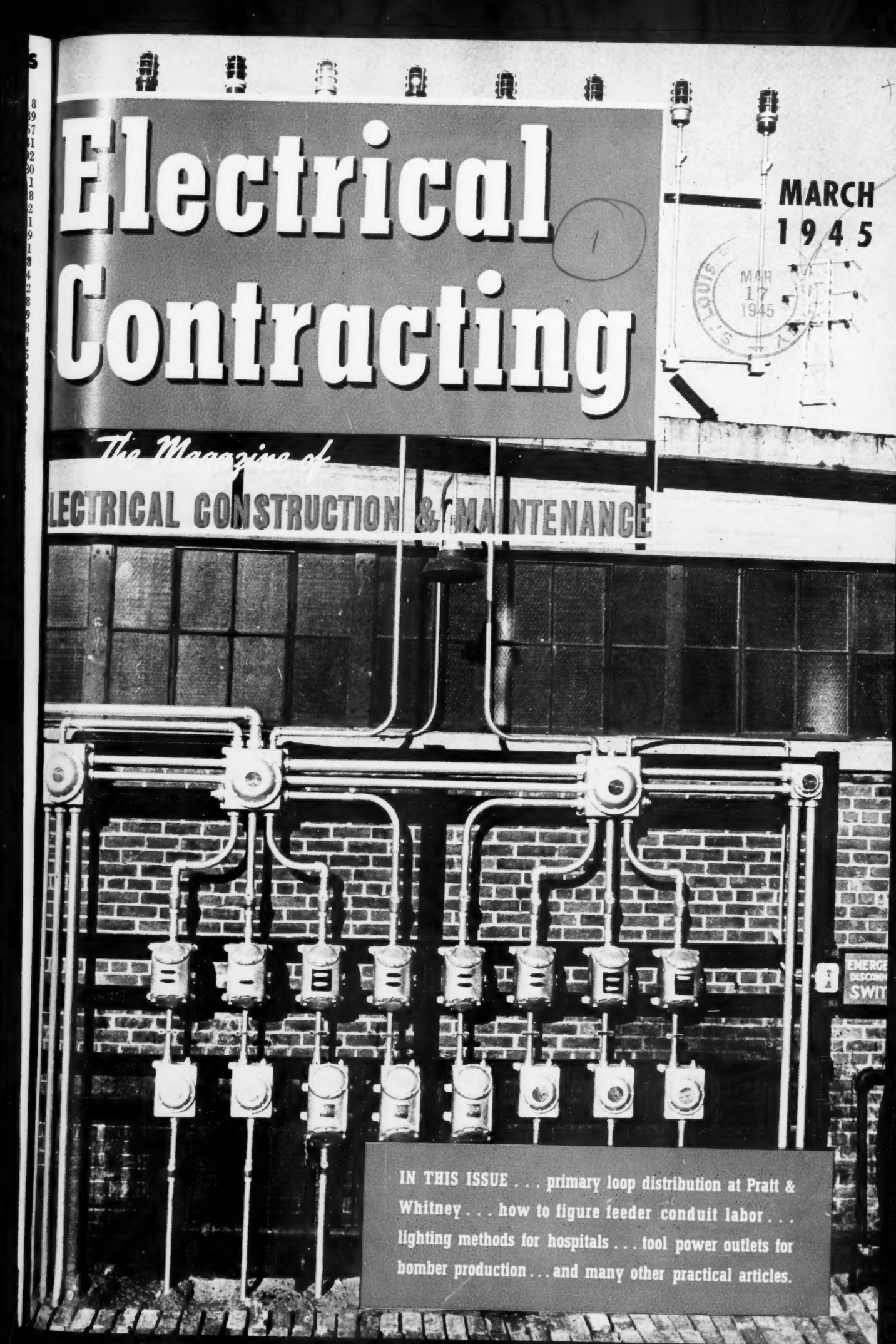
Electrical Contracting

MARCH 1945

The Magazine of ELECTRICAL CONSTRUCTION & MAINTENANCE



IN THIS ISSUE . . . primary loop distribution at Pratt & Whitney . . . how to figure feeder conduit labor . . . lighting methods for hospitals . . . tool power outlets for bomber production . . . and many other practical articles.

CAPACITORS REDUCE YOUR KVA DEMAND

"The capacitors reduced the demand of our welders from 150 kva to 54.6 kva. A serious wiring and power-factor problem within our factory was solved, and a bad light flicker was eliminated."

. . . An Illinois engineering firm

THEY BOOST A CIRCUIT'S LOADABILITY

"The 90 kva of capacitors increased our capacity 30 per cent. We've been able to connect more motors, without adding to wire, main switch, fuse, or transformer capacity."

. . . A Nebraska iron foundry

THEY IMPROVE VOLTAGE AND PERFORMANCE OF EQUIPMENT

"Voltage improved . . . power factor now unity . . . production speeded up . . . lighting flicker eliminated."

. . . A Michigan steel company

THEY REDUCE YOUR POWER COSTS *(if your power contract contains a power-factor or kva-demand clause)*

"With a total expenditure of $13,000 our savings have averaged $1000 monthly."

. . . An automobile manufacturer, Detroit

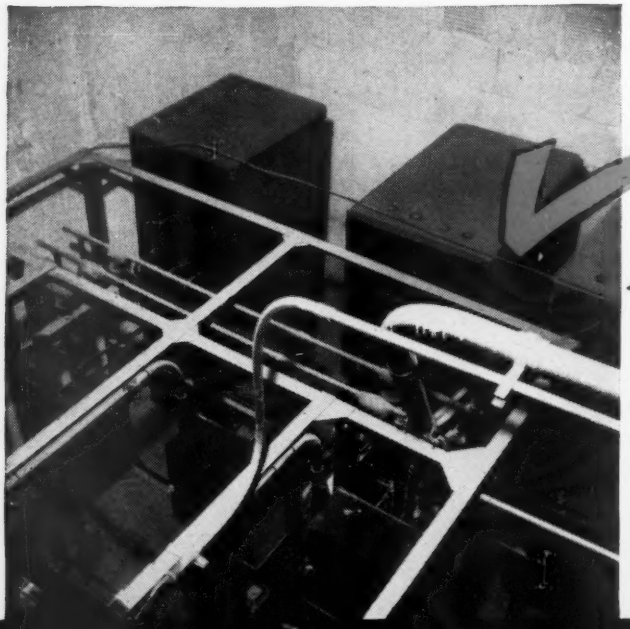
THEY SAVE MATERIAL

"Almost 50,000 pounds of critical material would have been required if new circuits had been added. With capacitors, only 4000 pounds of material was needed."

. . . A Midwestern paper manufacturer

THEY EASE RECONVERSION PROBLEMS

Capacitor equipments are assemblies of small, compact, individual units, easy to connect or disconnect, easily regrouped and moved to new locations—to serve your peacetime loads. They may make it unnecessary for you to relocate other heavier electric equipment.



PYRANOL CAPACITORS

◀CAPACITORS AUTOMATICALLY SWITCHED—The Allied Mills, Inc., Buffalo, N. Y., put in three banks of Pyranol capacitors totaling 200 kva to correct a bad power-factor condition that affected 1136 hp of motors. One bank has a hand-operated switch; the two other banks have automatic switches, actuated by a current transformer and relays, which connect or disconnect the capacitors with the rise and fall in the kva demand.

If your plant's power system is fully loaded—or overloaded—and is operating at low power factor, ask your G-E representative to estimate how much your circuit capacity can be increased by Pyranol capacitors. Or write for Bulletin GEA-77. General Electric Company, Schenectady 5, N. Y.

**Reg. U.S. Pat. Off.*

BUY WAR BONDS

GENERAL ELECTRIC

Electrical Contracting

Contents for MARCH, 1945

March—*at a glance* 55

Plain Talk About Labor—*An Editorial* 57

Primary Loops Serve Pratt & Whitney Loads 59
By ROBERT E. MILLER—Dual 4600 volt primary loops with secondary ties between load center substation provide flexibility and insurance against outages at Pratt & Whitney.

Selling Maintenance 63
By H. W. YOUNG—How planned selling, thorough service and efficient handling of small jobs builds maintenance business.

Estimating Feeder Conduits 64
By LEO W. WITZ—The third article in a series of discussions on estimating conduit work.

Lighting Techniques as Applied to Hospitals 68
By BERLON C. COOPER—A discussion of the application of basic fundamentals of good illumination for lighting hospitals.

Power Outlets Speed Plane Assembly 70
By AUGUST ECKEL—Fixed accessible power outlets on plane sections cut wasted production time 60 percent at North American Aviation's Texas plant.

How to Use Shunt Capacitors 72
By J. E. BARKLE—Power factor correction relieves overloaded transformers and creates additional load capacity where induction motors are used.

Relighting for Precision Work 74
How rehabilitation of the lighting system boosted employee morale and production in a Houston plant.

War Know-How Makes Postwar Jobs 76
By A. E. TYLER—Contracting plus specialties in light metals and plating open unusual postwar projects for the Sterling Electric Co. in Omaha.

War Presses Industry Progress 78
Abstracts of some of the papers presented at the AIEE winter technical meeting.

Explosion-Proof Wiring 81
Complete explosion-proof installation includes fool-proof grounding system for portable equipment.

Industrial Electrification 97
Selection and Application of Synchronous Motors—IV

Departments

Practical Methods 82
Questions on the Code.. 90
Data Sheet 108
Reader's Quiz 110
Motor Shops 120
Modern Lighting 126
Equipment News 130
Electronics 138
In the News.....150
Manufacturers News....178
Advertisers' Index.....200

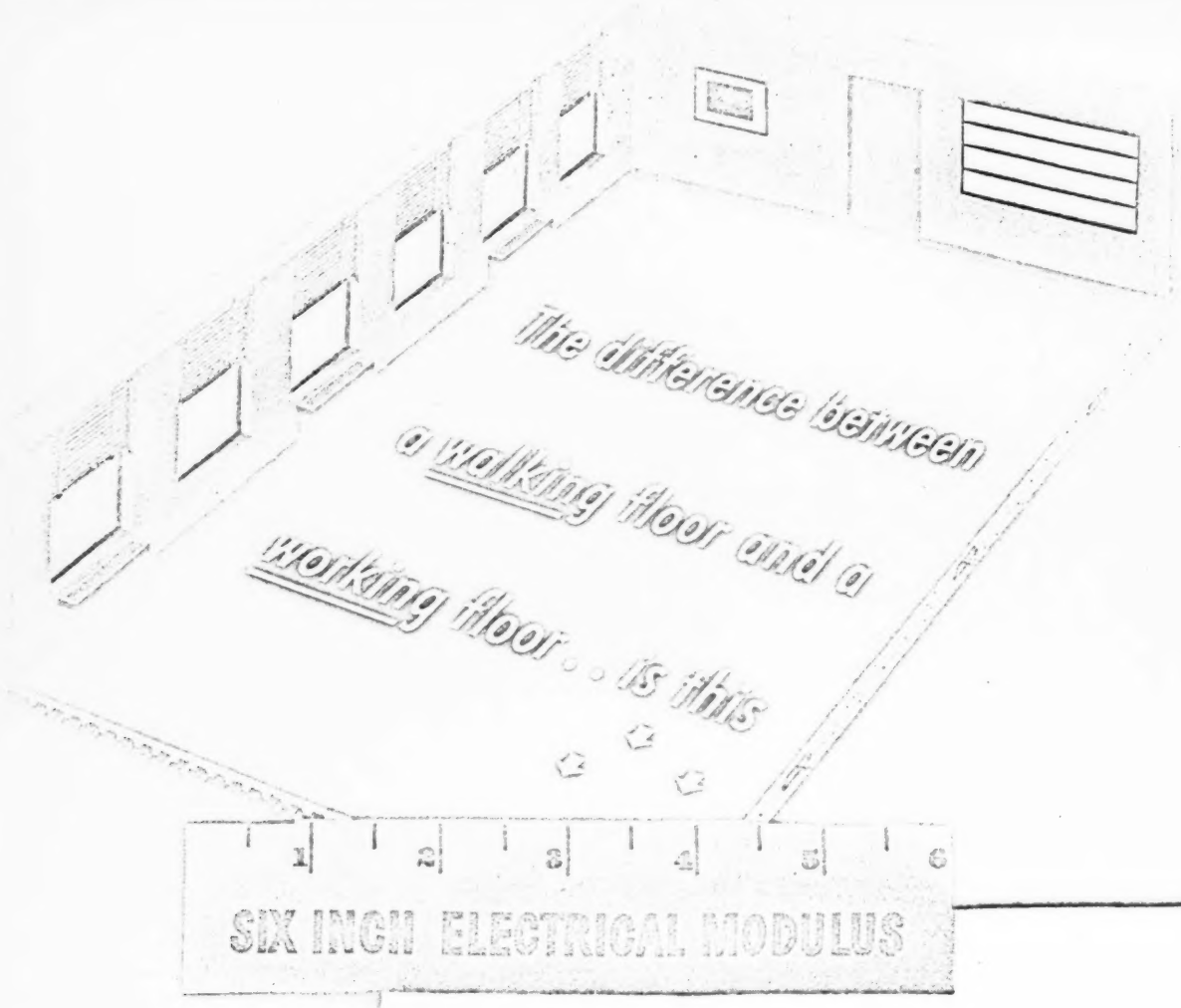
W. T. Stuart.....Editor
Alice McMullen.....Associate Editor
August Eckel....Middle West Editor
R. E. Miller.....Industrial Editor
Berlon C. Cooper.....Eastern Editor
W. A. Cyr.....Pacific Coast Editor
H. W. Young.....Southwest Editor
Harry Phillips.....Art Editor
W. K. Beard, Jr....Publisher
M. S. MacNaught..Manager

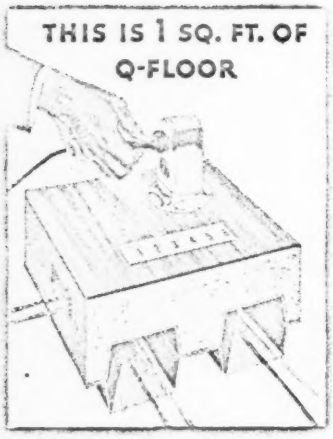
DISTRICT MANAGERS

S. A. Jones.....New York
F. J. Seiler.....Cleveland
W. B. Heaps.....Chicago
A. B. Conklin, Jr.....On Leave U. S. Army

McGRAW-HILL PUBLISHING COMPANY, INC. JAMES H. McGRAW, Founder and Honorary Chairman; JAMES H. McGRAW, Jr., President; HOWARD EHRLICH, Executive Vice-President for Business Operations; JOHN ABBINK, Executive Vice-President for Editorial Operations; CURTIS W. McGRAW, Vice-President and Treasurer; JOSEPH A. GERARDI, Secretary; J. E. BLACKBURN, Jr., Director of Circulation. Publication Office, 99-129 North Broadway, Albany, N. Y. Editorial and Executive Offices, 330 W. 42nd St., New York 18, N. Y. *Branch Offices:* 520 North Michigan Ave., Chicago 11; 68 Post St., San Francisco 4; Aldwych House, Aldwych, London, W. C. 2; Washington; Philadelphia 2; Cleveland 15; Detroit 26; St. Louis 8; Boston 16; Atlanta 3; Los Angeles 13; Pittsburgh 22. Member A.B.C. Member A.B.P.

A practical technical and management journal for electrical contractors, industrial electricians, inspection engineers and motor shops, covering engineering, installation, repairing, maintenance and management, in the field of electrical construction and maintenance.





Q-FLOORS

The six-inch electrical modulus is the new measure by which to judge a floor's electrical usefulness.

Robertson Q-Floors are built so that an electrical outlet can be established on any six-inch area. This permits the user to have electricity exactly where he wants it. It permits quick change of floor plans, encourages the use of more electrical equipment.

Q-Floors throw the emphasis on electrical service—when and where you want it. Buildings with Q-Floors boast electrical availability as an asset. Tenants are sold on the fact that they need only call an electrician to change their outlets and keep their floor plans up-to-date. They form the habit of wanting outlets when and where they want them!

Robertson Q-Floors promote the use of electricity and more frequent electrical service.

★ Designed
★ ENGINEERED
★ MANUFACTURED BY

Leader

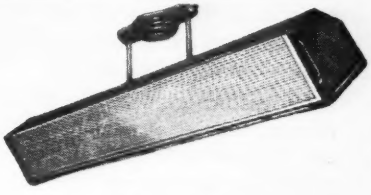
Accepted by the trade and specified by leading architects as paramount in the field of fluorescent light fixtures; Leader Units have been installed in ever increasing quantities throughout America's industrial and commercial organization. The Leader Electric Mfg. Corp. is known nationally for high standards of quality and workmanship. More important Leader straight-line merchandising methods assure jobber and dealer profits, in this, the fastest growing division of the electrical industry.

Your inquiry will receive the prompt attention of Leader Engineers.

ZUO Series:
Sturdy, streamlined industrial units available in two and three light 40 watt units and two light 100 watt units. Rigid all-steel construction. Designed for individual or continuous run installation.

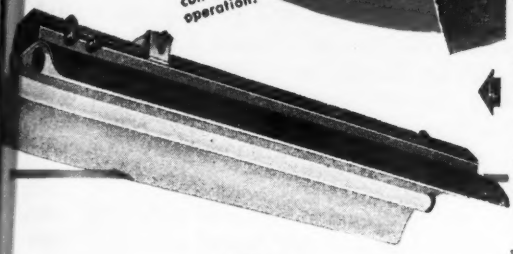
ZIU
Industrial units for concentrated and complex lighting installations, available in two and three light 40 watt units and two light 100 watt units. Designed for individual or continuous run mounting.

RECESSED TROFFER UNIT
Versatile installations, by the unit or by the mile, combined with quality workmanship and low maintenance costs make the new Leader Recessed Trofter unit outstanding in this field. Furnished in 12" width one or two light or 24" widths two or four light sections. Available with or without louvers and glass shielding. Constructed for conventional or instant start operation.

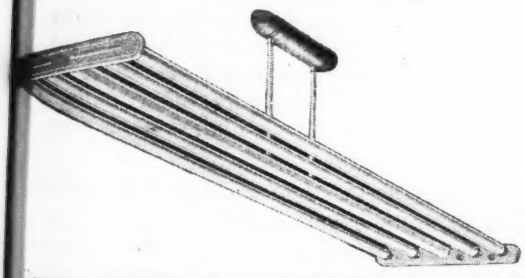


IUO-240:
The STRATOLINER—Efficient heavy duty industrial lighting unit well known to lighting engineers and architects. Reflectors have captive knurled clasps, preventing loss in servicing. Channels designed with grooves to take adjustable hanging clamps for flexible installations and light direction. Can be installed singly or in continuous run. Also available in three 40 and two 100 watt units. Constructed for conventional or instant start operation.

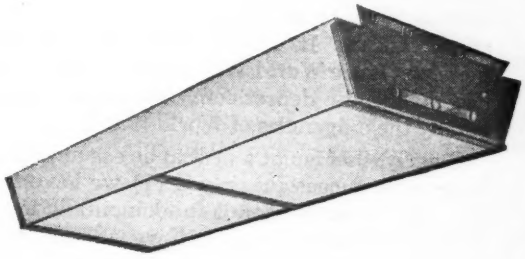
GL-240—GL-440:
Two light 40 watt, glass enclosed, louvred unit, unusually efficient, designed for pendant or ceiling suspension mounting, constructed for individual or continuous run installation.



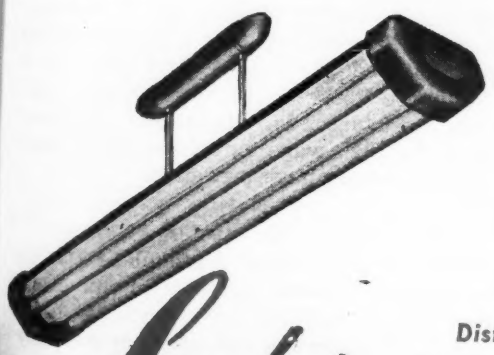
VO-440:
Four light 40 watt, parallel tube, open type luminaire. Remarkably simple to install, maintain, and service. Available for pendant or ceiling suspension mounting, continuous run or individual installation.



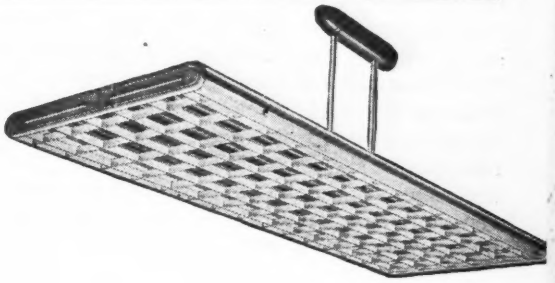
LR-440:
Four light 40 watt, glass enclosed unit, manufactured in accordance with the Utilities Research Commission specifications. Available for pendant or ceiling suspension mounting, individual or continuous run mounting.



L-240—L-440:
Four light 40 watt, parabolic, open type unit, specifically suited for drafting rooms and war production offices where general overall light is required. Available for pendant or ceiling suspension mounting, continuous run or individual installation.



VL-440:
The LEADER OFFICER — Four light 40 watt plastic enclosed, louvred unit, combining the finest in design, construction, and servicing feature, this unit offers the ultimate in lighting equipment. Available for pendant or ceiling suspension mounting, individual or continuous run installation.



Distributed only through the better Electrical Wholesalers.

THERE IS A LEADER REPRESENTATIVE IN YOUR AREA

Leader ELECTRIC MFG. CORP. • 6127 BROADWAY CHICAGO 40, ILLINOIS

AMERICA WANTS COMPETITION

Only American Initiative Can Preserve It in World Trade

AMERICANS generally agree upon what constitutes a desirable pattern of international economic relationships. We want an expanding world trade, with minimum recourse to government-imposed trade barriers and discriminatory trading arrangements, and offering ample scope for competitive private enterprise. Because they are necessary to such trade, we want also stability of exchange rates, and national currencies that are mutually convertible at least for the settlement of current accounts. We want, too, arrangements to facilitate long-term capital loans with security to the lender and advantage to the borrower.

Few other nations subscribe to these aims with enthusiastic conviction. Some reject them flatly as impractical under the conditions likely to prevail during the postwar period, or achievable only at prohibitive cost to their domestic economies.

Unless, therefore, we can formulate a practical and comprehensive program to carry out our aims, and convince other nations that we will take a sustained and responsible part in making it effective, the international trade of the world surely will be conducted under a system of exchange controls, bilateral agreements, cartel bargains, import quotas, and direct government purchasing arrangements that are the very antithesis of the competitive system that we favor.

To agree upon a concrete American **program**, and to convince other nations that it is to their advantage as well as ours to accept it, is a major task of economic statesmanship. It entails reversing a trend which has persisted since World War I, and which has been intensified during the depression years of the nineteen-thirties and by the exigencies of World War II.

Clearly, that is not a task to be assumed lightly. We can hope to be successful only if (1) we have a deep conviction that what we seek is fundamentally important to the American interest, and (2) if we will take pains to understand why other nations fear that such a program may jeopardize their interests, and then make whatever accommodations may be necessary to resolve their doubts.

An expansive foreign trade policy has been advocated so vigorously and repeatedly in America recently that The Economist (of London) comments wryly upon what it terms the ironic circumstance that "the acceptance of the principles of free trade by the more literate (American) public should come at a time when the doctrines in their simplest nineteenth-century form have been pretty generally emasculated in fact and repudiated in principle by the rest of the world".

☆ ☆ ☆

Why are we opposed to managed world trade, and for competitive world trade?

First, we are against rigged and managed international markets because we know that successful participation necessitates a comparable degree of control over the domestic economy as well. There is little debate of this fact, and those nations which accept a managed external trade as a necessary protective measure are generally willing to pay the price in internal regimentation. We are not. For us to do that would be as alien to our genius as it is repugnant to our conviction.

Second, we believe that the United States will be able to compete successfully in world markets, even though we have, and intend to maintain, wage scales far higher than those of the nations whose competition we must meet.

There is impressive evidence to substantiate the soundness of this conviction:

1. Wage scales, of themselves, do not determine the competitive position. They are meaningful only when translated into labor costs, by dividing wage rates by units produced. **A recent War Production Board study shows that in manufacturing industries generally, during the period immediately before the present war, production per man hour in the United States exceeded that in the United Kingdom, Germany and Soviet Russia by a ratio of more than 2½ to 1, and that of Japan by more than 4 to 1.** When comparison is made with available wage data, it appears that our labor costs are generally on a competitive plane.

2. Perhaps the best evidence of our ability to compete in export markets is the record of our demonstrated capacity to do so in the past. **During the entire period between World Wars I and II, the United States consistently commanded a greater share of the world's export trade than any other nation,** although the United Kingdom took a larger percentage of world imports.

3. We have been particularly successful in world trade competition in the export of machinery, vehicles, a variety of manufactured specialties, and certain agricultural products. Except in the last-named field, there is every evidence that we enjoy genuine competitive advantage over other nations, and this advantage will have been increased rather than diminished by developments during the Second World War. It is noteworthy that the goods in which we have been able to compete most successfully have generally been the products of our high wage industries rather than those in which low wages have prevailed.

☆ ☆ ☆

It is clear that, on a price basis, we shall be able to compete successfully in postwar markets in numerous lines. It is equally clear that such an opportunity is by no means of negligible importance to our own economy as a whole. During the years in which the censuses were taken between 1909 and 1939, our exports amounted

to from 7 to 16 per cent of our entire production of movable goods. **In the year 1938 our exports in each of the following lines accounted for more than 10 per cent of total domestic production of the particular product.**

(The figures in parenthesis are the percentages of total production exported.)

CRUDE MATERIALS: Phosphate rock (51.5), cotton (30.5), tobacco (29.4).

FOODSTUFFS AND BEVERAGES: Linseed (49.4), dried fruits (36.2), canned sardines (29.4), rice (21.0), fresh pears (15.9), canned salmon (13.8), canned asparagus (13.2), canned fruits (13.0), wheat (12.2), lard (11.7).

SEMI-MANUFACTURES AND FINISHED MANUFACTURES: Refined copper (53.1), paraffin wax (46.3), gum turpentine (42.6), carbon black (40.8), gum rosin (38.0), borax (35.9), crude sulphur (35.6), aircraft and parts (26.8), office appliances (22.3), carbons and electrodes (21.8), printing and bookbinding machinery (18.2), agricultural implements and machinery (17.0), biologic pharmaceuticals (15.3), industrial machinery (14.4), dental instruments and supplies (14.3), automobiles (14.1), benzol (13.3), goat and kid upper leather (12.8), refined lead (12.0), radio apparatus (11.8), caustic soda (11.4), refined mineral oils (10.6).

It is of major concern to all engaged in these lines of activity and in many others that foreign markets be not closed to us. It is particularly to our interest to have export outlets for our war-expanded capital goods and equipment industries. Since we undertook an important percentage of such expansion in order to furnish munitions to our Allies, it is reasonable to ask their cooperation in cushioning what inevitably must be a drastic readjustment here. The case is strengthened by the fact that the postwar world will desperately need the equipment items that we, alone, can supply.

But our demonstrated ability to compete on a price basis will not, of itself, assure us of foreign market outlets. Transportation costs, quality of product, marketing skill, technical and repair service—all are basically important. Still more important are non-discriminatory open markets and the command of dollar exchange by prospective purchasers. Our export potentials will surely be cramped in a world organized on the basis of bilateral deals and exchange controls. The availability of dollar exchange must depend upon the level of American imports and the volume of American capital loans.

☆ ☆ ☆

How are we to explain the skepticism of other nations toward an order which to us seems so clearly to represent not only our interest but the long-range interest of the world as well?

Soviet Russia, of course, is committed to conducting its external trade through its central government. But what of the United Kingdom? Why are there so many British voices that counsel the abandonment of what has been Britain's traditional position for more than a century? If we can understand that, we shall understand the dissent from our position of most nations whose economic positions have weakened and whose fiscal problems have multiplied during the two World Wars and the ill-starred period between them.

Essentially, their case is this:

Partly, they were forced into managed external trade policies by the Axis self-sufficiency programs, adopted in preparation for aggressive war. That can be corrected only by crushing the Axis, and by establishing a world security system that will make self-sufficiency a less compelling need.

But primarily, the reluctance of peaceably inclined nations to forego restrictive controls over postwar foreign trade stems from a deep-seated fear that is even more difficult to resolve. They fear, on the basis of past experience, that their efforts to meet payment balances arising from normal foreign trade would force a deflation of their internal economies, affecting prices, credit, wages, and finally employment. Faced with the choice, as they see it, between making adjustments in foreign trade or in their domestic economies, they lean toward the former as, at worst, the lesser of two evils.

☆ ☆ ☆

Since the kind of world trade system we seek is dependent upon international arrangements to assure reasonable stability of exchange rates between national currencies, we are challenged to find a formula that both will provide this and at the same time allay what other nations believe are legitimate fears with respect to their domestic economies.

But at least two major steps toward resolving such doubts can be taken upon our own initiative without recourse to the intricate process of international negotiation.

One is the rational overhauling of our tariff system, to provide other nations with increased opportunity to export to us. We can, and should, do this in a way that avoids undue cost to any segment of our economy.

The other, and probably the greatest contribution we can make toward winning a reluctant world to our point of view, will be to offer ample and convincing evidence that we are ready and able to provide a high level of employment in the United States. If we can do that, the rest of the world will wish to expose itself to our influence rather than to insulate against it, since prosperity here is the greatest single contributing factor to world-wide prosperity.

Balance of payment problems are minimized in a world of thriving trade. Britain would have little reason to resort to exchange controls if the total of postwar world imports and exports reaches an 80 billion dollar level. She may well be in a desperate plight if it should revert to the 1935 level of 40 billions.

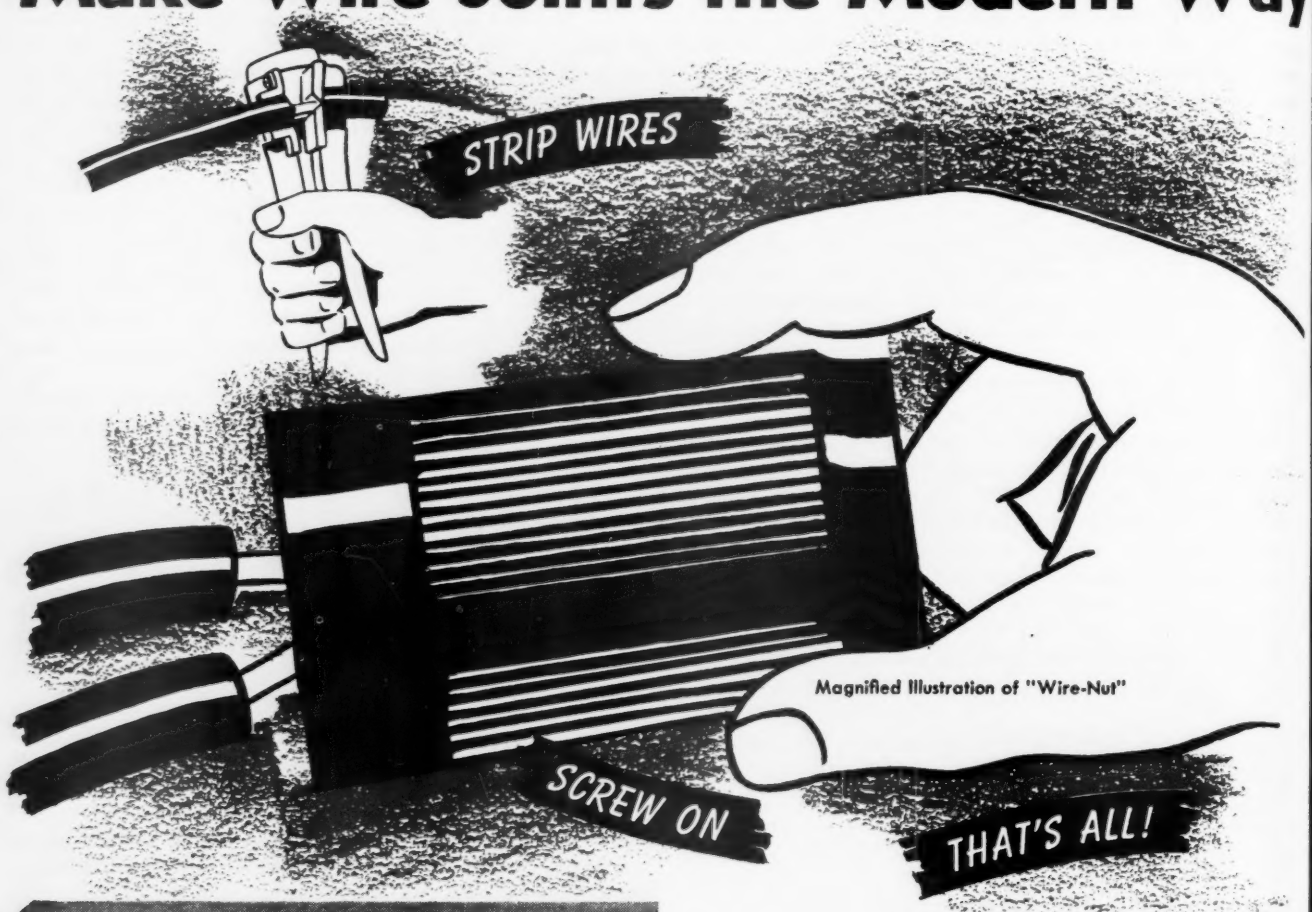
☆ ☆ ☆

The United States wants a world in which private enterprise and competition play a major role. To obtain such a world will require a wiser, more understanding and firmer world leadership than this nation, or perhaps any nation, ever has exerted heretofore.

President, McGraw-Hill Publishing Co., Inc.

THIS IS THE 33RD OF A SERIES

Make Wire Joints the Modern Way



Helping ELECTRICITY Serve America Better

Reconversion Time is *Rewiring Time!*

IDEAL "Wire-Nuts" (solderless, tapeless, wire connectors) make a neater, safer wire joint . . . better electrically...stronger mechanically. No fussing. Easy to use, simply strip wires, screw on . . . that's all. Recognized as standard throughout the Electrical Industry. Approved by Underwriters' Laboratories, Inc.

IDEAL WIRING DEVICES. Peacetime or War-time, wiring jobs must be finished fast. Each year more and more of these IDEAL Wiring Devices are used to simplify and speed electrical wiring.

- Wire Strippers
- Lugs, solder and solderless
- Fish Tape, Reels and Pullers
- Joist Boring Machine

IMMEDIATELY AVAILABLE

IDEAL "WIRE-NUTS"

A size for every job! Ideal "Wire-Nuts" are the modern wire connectors used in wiring—new circuits, rewiring, plant changes, relocating machinery, etc. You can make all wire joints without solder or tape—all you need is a pocketful of IDEAL "Wire-Nuts."

Wire Connectors are only one of IDEAL'S *100 Products* serving more than *40,000 Customers* through *200 Service Engineers.* Warehouses and Jobber Stocks located all over the country.

Send for FREE 88-page Handbook, describing IDEAL'S new and better products and methods.

IDEAL *Sycamore*

MARCH . . . . *at a Glance*

THE last few years have seen a remarkable rise in the use of higher voltage for in-plant distribution systems. And with high voltage distribution comes the use of network and loop systems to provide flexibility and insurance against local failures. . . .An interesting installation of this type was made by the Baldwin-Stewart Electric Company of Hartford at the Pratt and Whitney plant in Willimantic. Industrial Editor Bob Miller developed this story in cooperation with Paul R. Olson, Chief Electrical Engineer of Pratt and Whitney and E. M. Baldwin of Baldwin-Stewart. "Primary Loops Serve Pratt & Whitney Loads" will be found on page 59.

THE series of articles on estimating have attracted wide attention. It's doubtful if there's a subject of more use to everyone as the labor data material which Leo Witz, of the Continental Electrical Construction Company of Chicago, has presented in these articles. . . .In this issue he continues discussion of conduit work with labor unit tables and examples of their application to feeder conduit work. . . .Witz is a practicing estimator with a flare for gathering experience data.

RECEPTACLES are useless unless they are in the right place. This is true where trailing cords and poorly located equipment can be not only a nuisance, but a serious hazard. . . . At North American Aviation's Texas plant power outlets are now located directly on planes under construction and fed from overhead trolley ducts. . . . The story, "Power Outlets for Plane Assembly," as prepared by Midwest Editor August Eckel, in cooperation with North American Aviation's electrical department is told on page 70.

ED GRAFENTIN, of Sterling Electric Company in Omaha, can always be counted on for a good story. Many unusual ideas in lighting application and fixture design, which were a Sterling specialty before the war, had to be put on the shelf while they went to work on light metal work for Uncle Sam. But the know-how, the shop methods and techniques that were developed during the war are already the basis for postwar plans at Sterling. . . . Some of these ideas are presented in Correspondent Tyler's story, "War Know-How Makes Postwar Jobs" on page 76.

"HOW to Use Shunt Capacitors" by J. E. Barkle on page 72 can hardly be classified as light reading. Yet it is one of the best, most straightforward and useful discussions of the application of shunt capacitors to electrical systems where induction motors are used. It is a practical explanation that practical men will find immediately useful. It has enough mathematics to make it equally useful for those who like to figure their own power factor correction problems.

ONE of the greatest markets for lighting today is in the relighting of relatively small industrials. Many urgent war jobs can be aided by intelligent application of modern lighting principles. . . . "Relighting for Precision Work" on page 74 might be called a typical case where both general lighting and local lighting were used to fit modern lighting methods to the critical seeing tasks that had to be performed.

Because of the basic importance of adequate wiring to the entire electrical industry, Anaconda is presenting messages like this in a wide list of national publications.

IT'S YOUR POSTWAR ELECTRICAL HOME

—See that it works!

THINK of your electrified home to come . . . big and little appliances of all kinds . . . advanced heating . . . air-conditioning . . . better lighting . . . television . . . All fine servants—but they will be handicapped if you give them insufficient electrical capacity.

So often electrical wiring plans are based on *past* electrical experience—a poor guide to the needs of peak loads to come. It's far safer to plan *reserve* capacity in line with the huge future increase in electrical usage. You'll save yourself plenty of grief later in breakdowns and expensive alterations.

Manufacturers! Apply this in terms of industrial equipment in *your* business. The problem's the same. Make sure you have ample electrical capacity to meet the huge future increases in electrical usage sure to come. In plants too, planned wiring will cost a lot less than unplanned wiring.

Before structures get out of the planning stage, it will pay to consult electrical contractor, utility power engineer, plant power engineer. They'll agree that it's always wiser to *Wire Ahead!*

ANACONDA WIRE & CABLE COMPANY

25 Broadway, New York 4 . . . Sales Offices in Principal Cities

ANACONDA

It's Always Wiser to TELEGRAM WIRE TELEGRAM AHEAD

PLAIN TALK ABOUT LABOR

Let's look at the record. Strikes involving electrical construction mechanics during the last five years are practically non-existent. Top shelf men of NECA and IBEW have made labor management history in writing a joint postwar report. The machinery for settling labor disputes by arbitration existed, and worked effectively, long before the present government arbitration machinery was conceived.

Yet a high proportion of the men we quizzed on postwar industry problems rank labor and labor relations as the most serious we shall have to face when the guns are silenced. Many, entirely willing to be quoted publicly on other views, are silent on labor matters or will speak only off the record.

In individual instances such reticence is not particularly significant. The same attitude, however, encountered in many cities and among men with a wide variety of labor experience, becomes a symptom of suspicion and mistrust that cannot be ignored. It is a particularly dangerous symptom now.

The months and years ahead in the electrical business hold great promise. Technical advances, broad progress in electrical utilization, new horizons in power, light, communications and control will demand creative planning and intensive market development. Labor will share in the fruits or failures. Its interests are substantial. Its responsibilities are obvious. Its opportunities are clear. But does management look to labor for enthusiastic cooperation in market development? No! In spite of all assurances to the contrary, there is little confidence that labor's role in the necessary creative work postwar will be anything but a headache.

Why? Labor in recent years has demonstrated its power. Its top men have given us some fine demonstrations of labor statesmanship. But the rank and file of local leadership has yet to demonstrate a willingness to assume industry responsibility.

Autonomous locals have proved themselves tough and effective instruments to obtain high hourly rates and satisfactory working conditions. They can and do draw strong jurisdictional lines to assure that a high ratio of available labor hours are reserved to their membership. But all this is history. Tomorrow has no place for labor leadership content to use its might to defend the unchallenged. There are, however, unlimited horizons for labor leadership willing to tackle the great creative tasks ahead.

What can be done? Can the tremendous power which is labor's today, be directed toward industry objectives? We think so, but it won't be easy. Here are some suggestions that offer a beginning:—

(1) The unions should select promising men from the ranks for special schooling in electrical industry problems and objectives, and guide these men into local leadership.

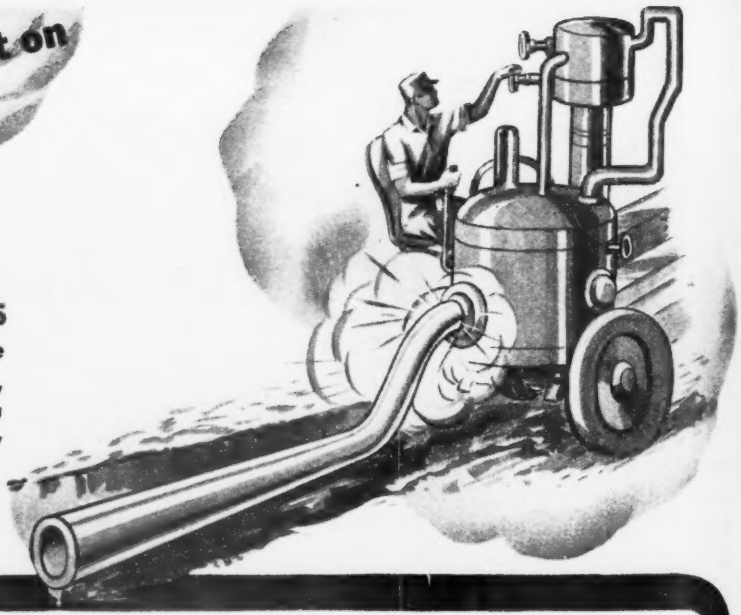
(2) Management should demand that the men who sit with them at the bargaining table be trained in industry objectives, and give them support and encouragement when they are.

(3) Local members should be given a thorough indoctrination in the responsibilities of modern labor practices and their relation to industry objectives.

The labor agreement that will be written this year and in the years to come can stifle initiative and freeze our industry into narrow channels of activity. Or, wisely and confidently written, they can give us a powerful and active partner, equally concerned with meeting every challenge that lies ahead.

Wm. F. Stuart

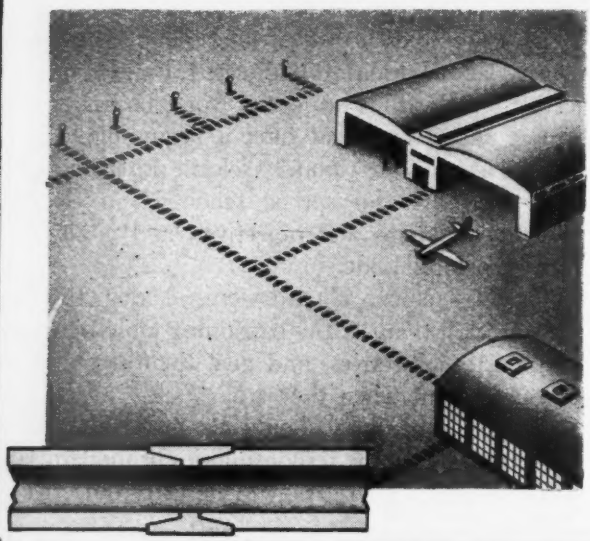
Post-war pipe dreams your customers can't count on



AN UNDERGROUND RACEWAY THAT'S EXTRUDED IN PLACE — One man makes the conduit and lays it as well. There's no handling, no joints. The extrusion hardens in place, and you can forget it forever. It may be available some day — but not tomorrow.

BUT THEY CAN PLAN RIGHT NOW TO —

SPEED UNDERGROUND WORK WITH NOCRETE CONDUIT



Orangeburg Nocrete Conduit, the ideal raceway for underground cable or wire, is easily handled and installed. Its flexibility enables the duct to follow the contour of the trench. Because Nocrete does not chip or break readily, handling losses are minimized. It can be sawed to length and field-tooled for joining. Joining requires no compound.

The smooth inner surface of all Orangeburg Conduits reduces cable-pulling tension and prevents damage to the cable sheath. Tight sleeve joints and impermeable walls make Orangeburg Conduits highly resistant to the entry of fluids.

Your Graybar Man will gladly work with you on procurement and help you select the right Orangeburg Conduit for each of your customer's needs.

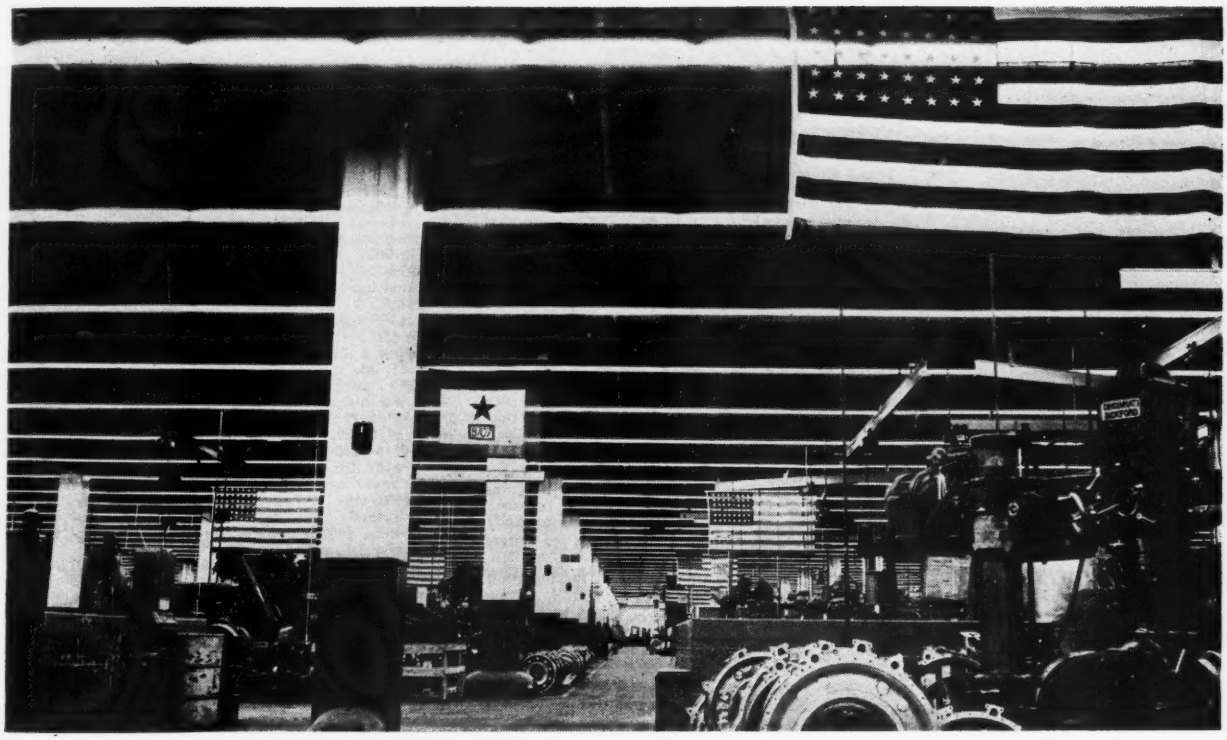
GRAYBAR'S NATIONWIDE NETWORK

of more than eighty warehouses assures you a convenient local source of supply for more than 60,000 electrical items — *plus* experienced aid on wiring, lighting, and applications of inter-communication and power apparatus. A Graybar Man near you is ready to assume personal responsibility for the electrical supplies that your contracts call for. His assistance can save you time.

4518

via GraybaR

ADEQUATE WIRING SERVES AND SAVES — THE KEY TO THE HOME OF TOMORROW



General view of machining floor showing continuous strip fluorescent lighting and bus-duct system with conduit drops from plug-in switches to the machine-tools.

Primary Loops Serve PRATT & WHITNEY LOADS

Dual 4600 volt primary loops with secondary ties between load-center substations which feed from opposite loops provide flexibility and insurance against outage at Pratt & Whitney plant in Willimantic, Connecticut.

By Robert E. Miller

Electrical experts responsible for the design and installation of the power and light distribution system at the Willimantic plant. On the left, E. M. Baldwin, Contractor, Baldwin-Stewart Electric Company and Paul R. Olson, Electrical Engineer of Pratt & Whitney Aircraft, Division of United Aircraft.

ENGINEERS were confronted with many problems in electrical distribution design during the construction of the numerous war plants which were erected to house the mighty U. S. production machine for war. Most of the problems were imposed by the times. The engineer found himself torn between sound design and an acute shortage of critical material. The continued cry for greater and greater production goals along with changing specifications made it difficult to estimate load requirements. In addition, good design called for as much insurance as possible against outage with the degree of protection commensurate with the degree of importance of continued operation. In normal times the effect of outages had been counted in dollars; but in war times, that effect is counted in materiel that never reaches the front. So again the designing engineer was confronted with a difficult task—that of providing maximum insurance with a minimum of critical material.

The electrical design in the Willi-

EQUIPMENT SCHEDULE

1 Strain insulators
2 Snap-tap clamps
3 34.5 kv. 400A. gang operated air break switch manually operated
4 3-20kv. lightning arresters
5 3-1500 kva. 22000/4600V. single phase OISC outdoor transformer
6 3-4.6 kv. lightning arresters
7 Flexible connection to indoor bus extending through wall of switch house
8 ¾" I.P.S. copper tubing on 34.5 kv. insulators
9 Space for future 3- single pole disc. sw.
10 Space for future O.C.B. 600A, 34.5 kv. 3-pole manually operated, 250,000 kva. interrupting capacity at 22 kv
11 C.T. with double secondary for differential and ground relays (future only)
12 3-23 kv. 200A. fuses and outdoor fuse mountings
13 1200 A. 15000v. 3-pole, 150,000 kva. int. cap. metal clad sw. gear manually operated, d-c trip, indoor type, 3 CO-relays (ground relay in main breaker only). Branch breakers 600 amp. capacity
14 3-800/5 double winding secondary C.T.'s for meters and CO relays
15 3 current transformers by power Co. for metering
16 400A. 5000v. three-way oil switch
17 Metal clad O.C.B. 600A. 15000v. 50,000 kva. interrupting capacity, manually operated, 3-100/5, 7500v. C.T.'s, ammeter, switch and three CO-relays
18 Non-inflammable filled 4400-440/220v. 750kva. 3 phase transformer with pothead on primary and throat connection to metal clad switchgear on secondary (for 220v. three phase power)
19 Non-inflammable filled 200kva., 3-phase 4400-120/208v. transformer for lighting.
20 2000A. 3-pole A.C.B. in metal-clad cubicle with provision for extension
21 2000A. 3-pole unfused switch built in cubicle with provision for connection to 2000 amp. bus duct.
22 3-pole A.C.B. in metal-clad cubicle. 120/208v. 3 phase 4 wire current rating as indicated (10,000 RMS interrupting capacity)
23 7500v. pothead
24 Fused disconnect switch for protective lighting
25 3-600/5 7500v. C.T. for CO-relays and meters
26 3-150/5 7500v. C.T. for CO-relays
27 3-40/5 7500v. C.T. for CO-relays
28 Provide for 2 power Co.'s potential transformers for metering
29 2-4400/115v., P.T.'s for owners metering, protected by fuses
30 25 kva., 4400/120/208v., three-phase control transformer protected by fuses
31 Secondary circuit breaker panel 1-100A. 3-pole and 4-20A. single pole
32 Trip battery and rectifier
33 3/C 500,000 C.M. 5000v. VCL cable
34 3/C No. 1, 5000v. VCL cable in 2" conduit
35 2000 amp. 3 conductor bus duct.

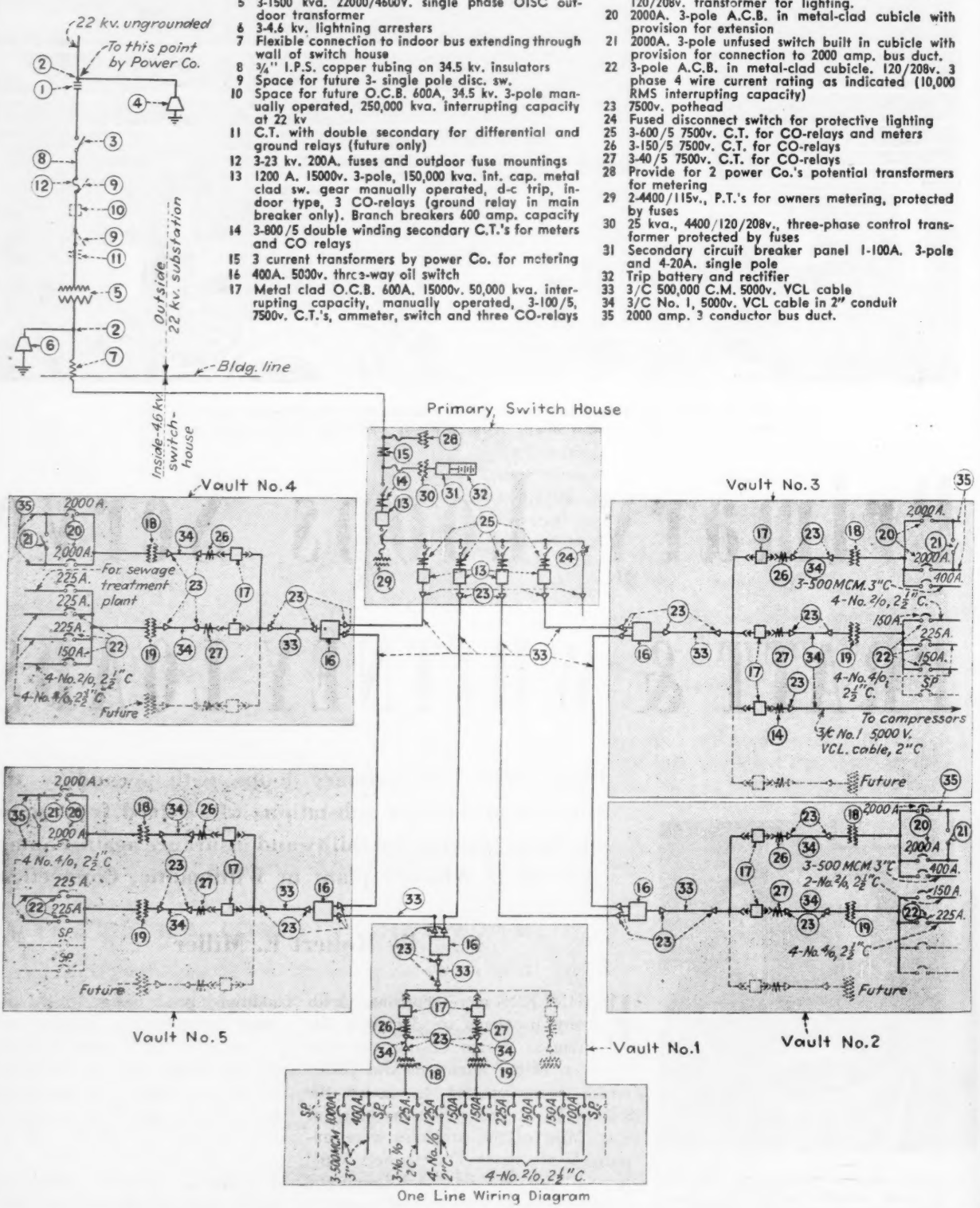
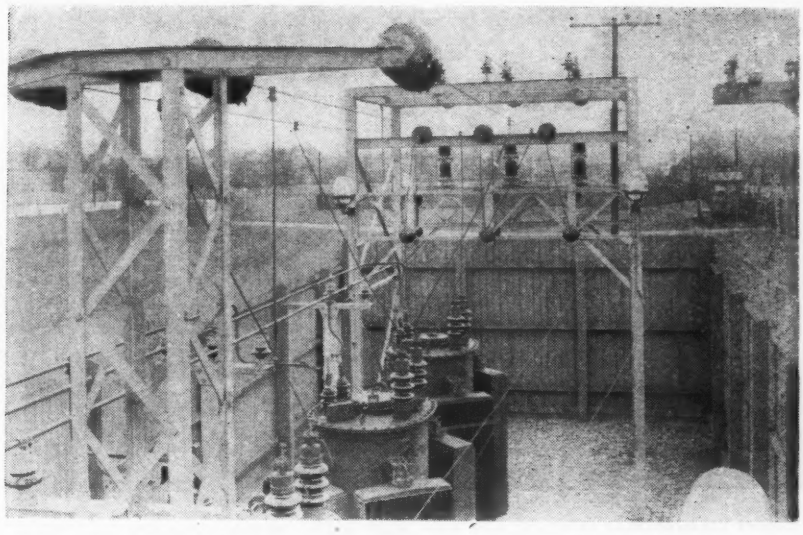


FIG. 1—One line diagram of the electrical power and light distribution system. Three-way switches on the 4600 volt loop-feeders permit any substation to operate from either or both directions.

mantic plant of Pratt-Whitney Aircraft Division of the United Aircraft Corporation is exemplary of these forced compromise designs required by the times. Willimantic is exclusively machining, and in approaching his distribution problem, Paul R. Olson, electrical engineer, drew extensively from experience in his other plants. Considerable time was spent in a thorough study of power requirements per unit area of plant space. Much thought was given to the possibility of closer spacing of machinery in anticipation of increased production quotas. Maintenance was an important factor. The major consideration was flexibility to meet the requirements of the continual rearrangement of machinery. This situation is characteristic of most machine tool plants where changing specifications and improvements in production technique demand machinery rearrangement to conform to the more efficient continuous-flow standards of production.



Outdoor substation with protecting enclosure transforms primary power at 22 kv. to 4600 volts for plant distribution. Three single phase oil insulated, self-cooled units provide a total capacity of 4500 kva.

Main Substation

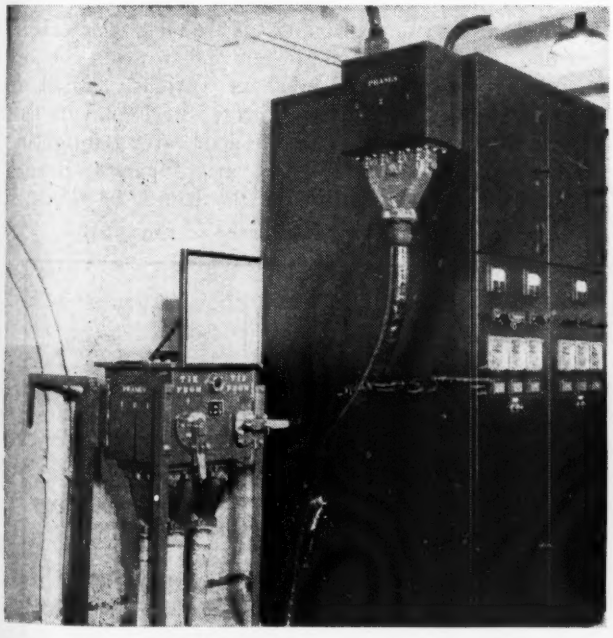
The distribution system as finally installed by the Baldwin-Stewart Electric Company of Hartford, Connecticut, is shown in the accompanying illustrations. As seen in the single-line diagram of Fig. 1, primary power is received in an outdoor substation at 22 kv. Present primary protection consists of 20 kv. lightning arresters and 200 amp. 23 kv. fuses. Provision has been made for the future addition of an oil circuit breaker flanked by single-pole disconnects, and also current transformers with double secondaries to give both differential and ground relay protection.

The three single-phase outdoor transformers are oil insulated, self cooled and rated 1500 kva. each at 22000/4600v. The 4600v. side of the outdoor station is also given lightning protection before the 4.6 kv. bus enters the switch house.

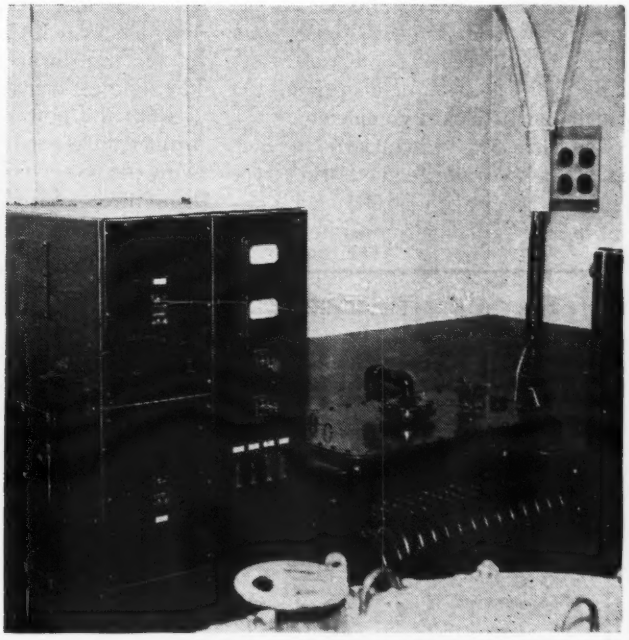
In the switch house the usual provisions are made for power company and customer metering. Also, a three phase control transformer interconnected with trip-battery and rectifier are connected ahead of main breaker.

Metal-clad switchgear, manually operated and equipped with d-c trip is used for switching the 4600 volt distribution circuits. The main-bus breaker is rated 1200 amperes at 15000 volts with 150,000 kva. interrupting capacity while the branch breakers are rated 600 amperes.

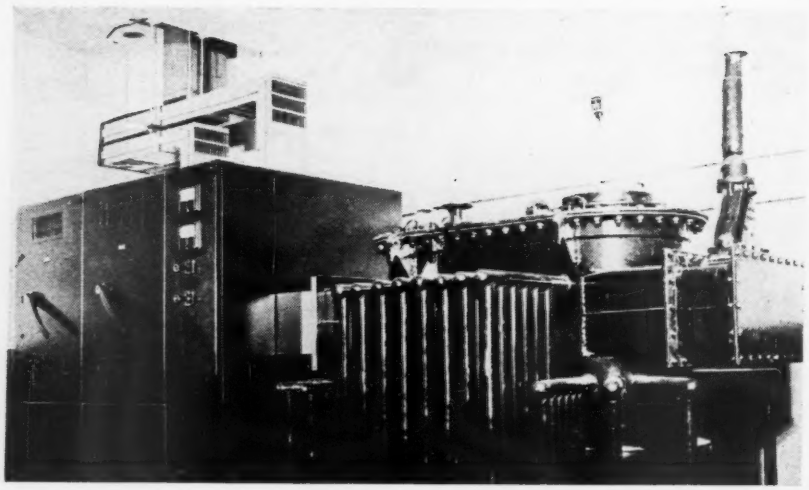
Four oil-breakers are used to switch the two loops serving the five load center substations. One loop feeds through vault 4, vault 5, vault 1 and back to the switch house, while the other supplies vaults 2 and 3. The individual three-conductor cables are carried in separate ducts of a multiple duct underground system connecting



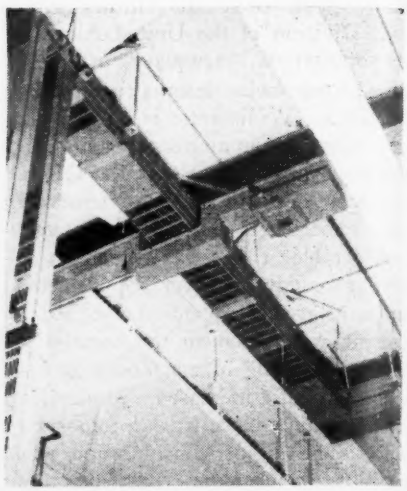
Loop feeders enter three-way switch from left through potheads. Third cable from tie switch enters primary switchboard. Feeders leaving at top are 4600 volt primary connections to lighting and power transformers.



Lighting transformer rated 200 kva. with metal-clad throat-connected secondary switchgear. Main breakers are air-break variously rated. Lighting mains are 3 phase, 4 wire 120/208 v. and leave from top of cubicle.

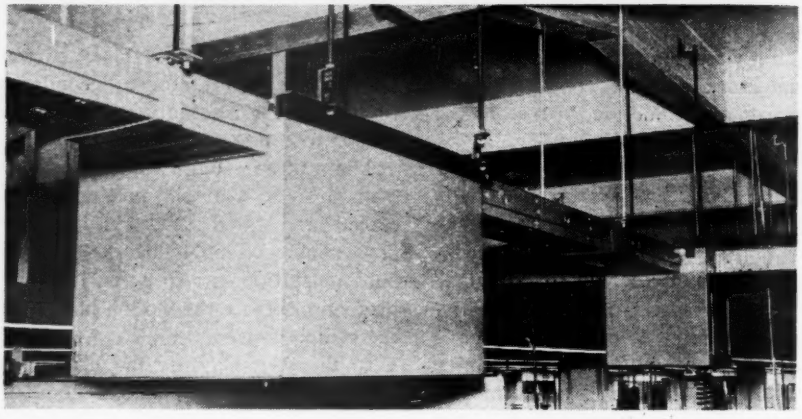


Power transformer is rated 750 kva. with three phase, three wire 220 volt secondary. Two air-breakers and two 2000 ampere bus mains supply the plant power requirements. Bus tie-switch is in back of board.



Bus duct mains rise from basement vault to machining area ceiling. Note 500 ampere plug-in bus duct.

the switch house and the first manhole within the plant located approximately midway between vaults 3 and 4. Cables separate at this point completing their respective loops in the shortest possible distance. The entire duct system is composed of Transite duct in concrete envelope with adapters to steel conduit used for substation risers and to enclose all cables used in the lighting system. The 4600 volt loop distribution cables are three-conductor 500 MCM 5000 volt VCL. Three-conductor 7500 volt potheads are used throughout the 4600 volt system at every point of entrance or exit from individual units.



Tie switch connecting the 2000 ampere bus duct mains from vaults 3 and 4. Fuse tap box is seen at right for the 500 amp. plug-in duct take off.

As seen in Fig. 1, each vault has two incoming 4600 volt feeders which are brought together in a three-way 400 ampere switch. By this means the primary switchboard can feed from either or both feeders, or it can be set in the "off" position de-energizing the primary switchboard completely.

The primary switchboard in each case is a two-cubicle metal-clad type with two 600 ampere 50,000 l.c. oil circuit breakers, manually operated. Each cubicle is complete with ammeters and switches, and overcurrent relays and test blocks with one breaker in the power transformer circuit and one in the lighting transformer circuit.

Both the power and lighting transformer tanks are non-inflammable filled with the power transformers rated 750 kva. three phase 4400/220 volts, and lighting transformers rated 200 kva. three phase, with 120/208 volt four wire secondary switchboards. Lighting switchboards are metal-clad cubicle type with meters and switches, and air-circuit breakers variously rated to meet requirements. Steel conduits cast in the concrete floor carry the lighting mains to the various panels. Branch circuits leave the panels in risers to

[Continued on page 184]

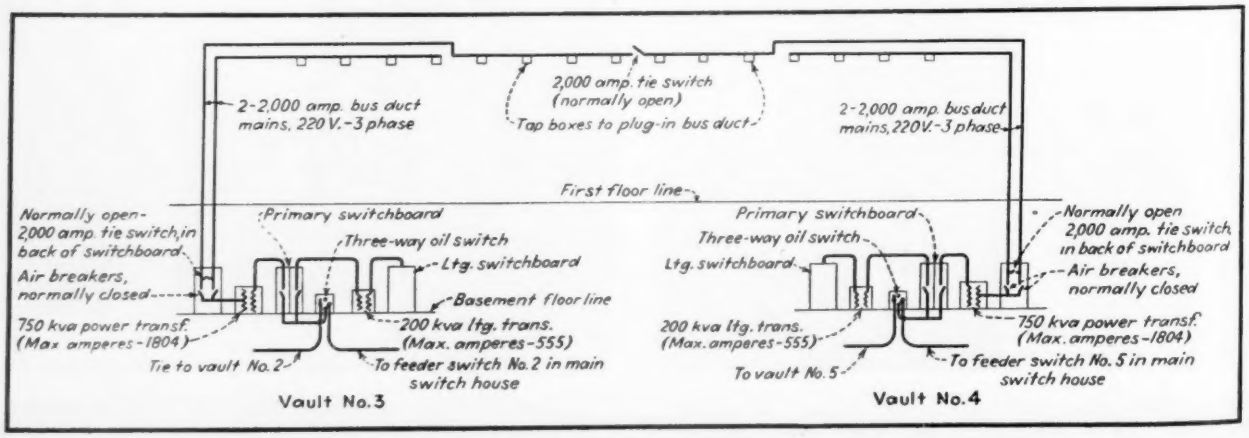

2-2,000 amp. bus duct mains, 220 V.-3 phase
2,000 amp. tie switch (normally open)
Tap boxes to plug-in bus duct
2-2,000 amp. bus duct mains, 220V.-3 phase
First floor line
Normally open-2,000 amp. tie switch in back of switchboard
Primary switchboard
Three-way oil switch
Ltg. switchboard
Air breakers, normally closed
Basement floor line
750 kva power transf. (Max. amperes-1804)
200 kva ltg. trans. (Max. amperes-555)
Tie to vault No. 2
To feeder switch No. 2 in main switch house
Vault No. 3
Primary switchboard
Three-way oil switch
Ltg. switchboard
Normally open 2,000 amp. tie switch in back of switchboard
Air breakers, normally closed
200 kva ltg. trans. (Max. amperes-555)
750 kva power transf. (Max. amperes-1804)
To vault No. 5
To feeder switch No. 5 in main switch house
Vault No. 4

FIG. 2—Diagram showing secondary and primary interconnection for flexibility and insurance against complete outage in any particular area.

SELLING MAINTENANCE

By H. W. Young

Planned selling, thorough service, efficient handling of small jobs builds steady maintenance business.

THE American Electric Construction Co., of San Francisco, has stepped up activities in the maintenance and repair field by organizing a special department for the work, employing seven or eight men constantly. Jobs solicited and executed by this department range from $10 up. This is a significant fact considering that last years' business of this company, including cost plus set government work, was in excess of three and a half million dollars.

Roughly, the jobs executed by this department average around $200 each, but they are considered highly important. G. A. Meyer, owner of the company, states that the work done by the department, even the smallest job not only has a distinct publicity value but is making a definite start toward the filling in of the gap which may be expected between the time of discontinuance of wartime construction and the resumption of civilian business on a full-scale basis.

Business is sought among all commercial and industrial enterprises having an MRO rating of some type which can be extended for purposes allocated in the priority system. The contractor also comes in as a repair man on such work under AA3V3. Under these conditions, a fairly free flow of material can be secured, so that the department can solicit the business freely, handle the jobs promptly and guarantee full compliance with city ordinances.

Maurice Levy, a former city electrical inspector, heads the department as survey engineer. He handles his job in a sort of personalized way all his own. His methods embody several fundamental procedures. (1) Does some old-fashioned, cold-turkey canvassing of industrial and commercial plants. (2) Follows up every inquiry for repair or maintenance work—no matter how small—and makes complete survey of the plant to ascertain what may be actually needed to make the plant up to date, safe and economical from the standpoint of the whole electrical installation. (3) Seeks to get in as electrical engineer on complete new installations. (4) To get electrical work does not hesitate to bid as "general contractor" on complete buildings, roadways, interior remodeling and finishing and whatnot, sub-contracting the non-electrical work. (5) Helps prospective customers with their priority problems to get them in a position, if possible, so that they can become actual customers. (6) Through his knowledge of rules and regulations applying to city work, shows customers how he can save money on his installation or maintenance work without impairing efficiency.

G. A. MEYER, owner of the American Electric Construction Co., of San Francisco

Levy also works in close cooperation with the job superintendent of the department, B. C. Gray. In some cases, Levy has done the necessary ground work in his survey, and the plan agreed upon between him and the customer is turned over complete to Gray. But the latter also has his own selling contacts where he may handle both the survey and construction ends. In the case of both, the objective is always to sell the customer what he should have for an effective, economical installation.

How this works out is illustrated by Mr. Levy through two or three specific examples. Take the case of one small manufacturer with a war contract. He called in and said that he needed a 10 hp. motor, and that was all he mentioned. Before delivering it, a survey was made of the whole plant and it was found that the whole system was badly overloaded. The distribution, originally all right, was now very bad. The result of the survey was that the customer was sold on putting in a new, flexible distribution system, new switchboard, larger service, and the taking on, from American's maintenance department, of a full-time maintenance man. These things were done, and on various occasions the one maintenance man was augmented to as many as six, because the customer had electrical work included in the product he was turning out and because conditions required frequent moving of equipment. Since the initial steps were taken, the billings to this customer have run to between $30,000 and $40,000.

In another case, Levy went in cold turkey on a food product factory from which they had never received any business before. The superintendent of the plant dropped the remark that he would like to get a small ventilating fan, not easy to procure at that time. As a preliminary step, Levy rustled up a fan that would serve the purpose and had it out there in two days. Then came a survey of the whole wiring system, which in the beginning had not been done properly from the standpoint of safety, and the condition being aggravated by overload conditions. This was explained and he was asked to go in and fix the whole thing up. This was done and then an adequate lighting installation was proposed, which went through with fluorescents.

Three trucks are maintained to handle the work of the maintenance and repair department. They are kept loaded with the ordinary supplies, equipment and tools, and can go from job to job without special trips back to headquarters for supplies.

ESTIMATING

***TYPICAL FEEDER INSTALLATION** where conduit supports and pull box terminals present a major labor item in the estimate. A clear picture of job conditions is essential at the time the estimate is made so all details can be adequately covered.*

Continuing previous discussion on conduit work, this article, Part III of a series, reviews the factors to be considered when estimating feeder conduit installations.

FEEDER conduit work involves operations different from branch circuits and data is handled differently because of the very nature of the factors involved and the type of estimating system we employ. You will recall that previous articles on estimating conduit work (*Electrical Contracting,* August, 1944, September, 1944) confined the discussion primarily to branch circuit installations.

The labor units which applied to branch circuit installations were formulated with certain absorptions of portions of the completed job being made at the outlets; others in the conduit labor. The "outlet" labor included all deviations from "straight run" conduit labor—such as bends, cuts, threads, terminals, etc. The "straight run" labor units included fastening the conduit to the building construction (including the normal quantity of straps required), since it is easy to anticipate the type of construction to which branch circuiting will be mounted. The differential in branch circuit "straight run" conduit units represented the difference in labor required for fastening to the various types of building construction. (These values are shown in Table III, pg. 51, *Electrical Contracting,* Sept., 1944.)

The approach to estimating feeder conduit installations differs, primarily, in that there is no continuous repetition of installation procedure. Large size conduits normally will be suspended from the building construction. *Assumptions and allowances cannot be made* for: Average number of elbows and/or offsets per 100 feet; average number of pendant hangers per 100 feet (larger subfeeders often parallel each other and use common hangers); average number of terminals per pull box (unlike outlets, a pull box may have only one conduit passing through it; or may have dozens of conduits entering and leaving it).

It becomes apparent that, for conduit feeders, a separate labor unit must be developed for each deviation from a strictly straight run condition. As each installation will vary, there can be no absorption at pull boxes for such deviations and these separate labor units (See Table II) must be added to the "straight run" units outlined in Table I. These deviations fall into the following categories:

1. Conduit Terminals
2. Conduit Elbows
3. Conduit Offsets (field bends)
4. Conduit Nipples
5. Conduit Fastenings and Supports

The application of labor units for each of the above classifications is demonstrated in the sample estimate outlined in Fig. 1. Taking each group separately, let's determine what each involves.

Conduit Terminals

The labor unit for conduit terminals will apply wherever a conduit either *enters or leaves* a pull box or enclosure. Hence, if a conduit feeder were being installed from point "A" to point "B", with a pull box in the run, there would be four terminals: One each at points "A" and "B" and two at the pull box. To analyze the labor tasks involved in this conduit run, let's consider each terminal as a separate job.

At point "A" the electrician would normally start with a threaded end and the only labor would be for fastening to the enclosure (contingent of course, on the enclosure containing the proper

FEEDER CONDUITS

By Leo W. Witz
Continental Electrical Construction Co.
Chicago, Illinois

size knockout). Where the conduit enters the pull box, the electrician would have to cut, thread, and fasten the conduit to the box (barring the remote possibility that the pull box will occur at the end of a standard length of conduit). Where the conduit leaves the pull box the electrician would start with a threaded end and at point "B" he would again cut, thread and fasten the conduit to the enclosure.

For each pair of terminals—leaving one enclosure and entering another—there would be a minimum of one cut, one thread, and two fastenings. This would still leave a conduit with a bald end following the cut and thread at the second terminal. To absorb this eventual thread, each terminal labor unit embraces one-half of a cut, one thread and two fastenings to the enclosures.

For thinwall conduit, on sizes up to 2-inch, the terminal labor will be considerably less due to the easier cuts and the no thread termination.

Conduit Elbows

The conduit elbow labor unit will apply wherever a manufactured elbow is inserted in the conduit run. The unit includes the necessary cut and thread in the conduit run, and coupling the elbow. No labor is included in the elbow unit for the conduit footage of the elbow.

If a conduit run from point "A" to

Project _____ CONTINENTAL Electrical Construction Co. Date _____

	MATERIAL	MAT. UNITS	EA. C. M.	MAT. COST	LABOR UNITS	LABOR HOURS
	INSTALLING FEEDER FROM EXISTING USER					
1	2" NIPPLE (MFG.) 18"		Ea.			.45
6	2" LOCKNUTS					—
6	2" BUSHINGS					—
1	200 AMP. 3PSW SWITCH		Ea.			2.0
3	175 AMP. 1-TIME FUSES					—
230'	2" R.S. CONDUIT		C		9.0	20.7
3	2" ELBOWS		Ea.		.70	2.1
3	2" COUPLINGS					—
1	PULL BOX - 14" x 14" x 6"		Ea.			3.4 *
4	⅜" RODS - 12" LONG					—
4	⅜" LARGE WASHERS					—
2	2" 1-HOLE STRAPS		Ea.		.30	.60
14	¼-20 A-J SHIELDS					—
10	3/4" - ¼-20 BOLTS					—
30	¼" EXPANSION SHIELDS					—
30	¼" RODS - 18" LONG					—
30	CLEVIS HANGERS		Ea.		.50	15.0
1	32 CKT. PANEL (NYIP)		Ea.			12.1 **
32	PLUG FUSES - 15 A.P.					—
730'	3/0 CABLE - TYPE R					—
3	500 MCM to 3/0 "T" TAPS					—
	SPECIAL LABOR (MISC. WORK AND CABLE PULL)					35.43
	TOTAL MANHOURS					91.48

SPECIAL LABOR	LABOR UNITS	LABOR HOURS
MISCELLANEOUS WORK		
4 2" TERMINALS (HEAVY TALL)	Ea. .80	3.2
9 3/0 LUGS	Ea. .35	3.15
3 500 MCM TO 3/0 TAPS	Ea. .80	2.4
CUT OUT 2" K.O. IN DIST. PANEL		
REMOVE SIDE ENTRANCE PANEL ON DISTRIBUTION CKT., REPLACE		1.5
1 OFFSET - 2" HEAVY TALL	Ea.	1.0
CABLE PULL***		
1 140° SETUP - 3/0 (TABLE 1)		1.35
1 90° SETUP - 3/0 (TABLE 1)		1.20
3 230° LAYOUT - 3/0 (TABLE 2)	1.15	3.45
PULL 730' - 3/0 CABLE (TABLE 3) M	19.70	14.38
3 RINGS SETUP (140°-3/0)		1.00
		35.43

NOTES:
* — See "Estimating Special Boxes and Troughs" Electrical Contracting, May, 1943, Pg. 42.
** — Includes labor for trimming branch circuits at 0.20 man-hours per circuit.
*** — See "Estimating Cables in Conduit," Electrical Contracting, April, 1944, Pgs. 51-53.

DESCRIPTION OF WORK

Job consists of tapping an existing back-wired distribution panel, fed from a 500 MCM cable riser which continues up through the building, and running a 2-inch feeder to a lighting panel. One side of the distribution panel back-wiring pocket must be removed, a 6-inch portion cut off, a 2-inch K. O. cut in this 6-inch piece which is then replaced after making a No. 3/0 solderless tap to the 500 MCM cable riser. This will permit installation of a nipple from the side of the distribution panel and still provide an access panel—now 6-inches smaller.

Caution: It is often impossible to make a "T" tap to riser cables in the limited space provided by a 12-inch back-wiring pocket. Frequently the entire panel must be removed and replaced. Overtime must be allowed for work to be done after normal working hours to prevent service interruptions.

The side panel nipple will run directly to a switch mounted adjacent to the distribution panel. For arbitrary reasons, assume an offset is necessary to reach the horizontal line of the 2-inch conduit feeder after it leaves the switch.

A pull box is inserted in the 2-inch feeder run; conduit is to be suspended 18-inches below a concrete ceiling and pull box must be supported at proper height with short rods.

Clevis hangers are to be used to suspend the conduit with a one-hole strap used on the walls at each end of the feeder run.

Several items indicated in this sample estimate have been discussed previously (See Notes Above) and are included without additional comment to complete the estimate.

***FIG. 1—SAMPLE ESTIMATE** shows segregation of labor units discussed, and detailed take-off of material items. Work at existing distribution panel, feeder tap, offsets and cable set-up is listed under "special labor" to make certain no items are forgotten. Note references to previous articles on pull boxes and cable installations.*

point "B" has a lineal dimension of 100 feet, for estimating purposes and even for material purchases from the estimate, it is well to figure the entire 100 feet plus the risers at points "A" and "B"—making no deduction for the conduit of which the elbow is formed. The reasons for this are twofold:

1. Such elbow deduction would call for reference to outside tables for elbow length along the radius.

2. It would leave no "buffer" for offsets which may not be anticipated, and would make no provision for minor waste such as the short pieces of conduit which return from every job.

In short runs—services, etc.—where there is no room for minor error, it is often advisable to consider the length of the conduit elbow. When this is done, that length should be added to the conduit footage so that the total length is covered in the conduit installation labor units. Again, the unit for thinwall conduit will be less since there is no thread and the cut is easier.

Conduit Offsets

Conduit offset labor units are applied wherever there is a change of direction in a conduit run not utilizing a manufactured elbow. Normally hydraulic tools will be used for conduit sizes over 1-inch. The labor units cover measuring, setting up the equipment, and completing the 90 degrees of bend. The units, shown in Table II, are based on two men working on a field offset.

On jobs where the only work consists of installing large feeder conduits and there are, for arbitrary purposes, four men on the job, there is often nothing for anyone to do while the bend is being made. Such conditions can be quite common depending upon the general nature of the work. It is frequently advisable to exercise sound judgment in the use of the units under job conditions as described.

Conduit Nipples

This labor unit can be applied wherever there is a short nipple between enclosures. The unit covers the labor for cutting and threading one end of a conduit length; threading the bald end caused by the cut; and the installation of the nipple between cabinets, or enclosures. This contemplates installing a short nipple only, the length not to exceed 3-feet. The unit is liberal enough to cover the possibility of cutting knockouts *on occasion*, but *it does not cover cutting knockouts for each nipple installed.* Where a short nipple is required to complete a conduit run, such nipple labor is included in the terminal units and conduit installation labor. *The nipple labor units in Table II apply only to nipples between two adjacent enclosures.*

These units are segregated into two types—job fabricated, and manufactured or ordered to size. Units for nipples ordered to size, are naturally lower than those for nipples fabricated on the job. It is necessary to decide which to use *when you make the estimate.* Normally, larger nipples can be ordered, and the smaller ones made up on the job—unless there is a substantial quantity involved.

Much of the foregoing has been discussed in the previous articles on branch conduit work. It is even more applicable to heavy conduit installations where the individual labor units outlined in Table II are used more frequently. Hence, we feel that, in the

Table I

FEEDER CONDUITS — STRAIGHT RUN
(Thinwall and Heavy Wall)
Man Hours Per 100 Feet

Conduit Size	NO. OF PARALLEL CONDUITS PER RUN				SPECIAL RUNS	
	1	2	3	4 and up	A	B
½-inch	2.5	2.2	1.9	1.8	6.0	2.2
¾-inch	3.0	2.7	2.3	2.2	7.7	3.0
1-inch	4.5	4.0	3.4	3.2	9.0	3.5
1¼-inch	5.5	5.0	4.3	4.0	10.5	4.5
1½-inch	7.0	6.0	5.1	4.8	13.0	6.5
2-inch	9.0	8.0	6.8	6.4	15.5	8.5
2½-inch	12.0	10.0	8.5	8.0	20.0	10.0
3-inch	15.0	13.6	11.5	10.9	25.0	12.0
3½-inch	17.0	15.2	13.0	12.1	27.0	14.0
4-inch	20.0	16.0	13.6	12.8	32.0	16.0

Notes:

Labor units are for stringing straight run conduit only; fastenings are separate units (see Table III).

Units apply to both thinwall and heavy wall conduit. Experience indicates weight factor is offset by increased labor at couplings on E.M.T.

A—Short Vertical Pours—involves considerable non-productive labor.

B—Open Trench—no labor for trench included.

Units apply to mounting heights of 12 feet and under; add 5% to above units for each additional foot above 12 feet; above 20 feet figure scaffolds (As shown in Table II, pg. 50, Electrical Contracting, Sept. 1944).

Table II*

ADDITIONS TO "STRAIGHT RUN" CONDUIT LABOR
Man Hours Each

Conduit Size	TERMINALS		ELBOWS		FIELD BENDS		JOB NIPPLES		Mfg. Nipples
	H.W.	T.W.	H.W.	T.W.	H.W.	T.W.	H.W.	T.W.	H.W.
½-inch	0.15	0.10			0.08	0.04	0.20	0.15	0.15
¾-inch	0.20	0.15			0.10	0.05	0.30	0.20	0.20
1-inch	0.30	0.20	0.25	0.15	0.40	0.15	0.35	0.25	0.25
1¼-inch	0.40	0.25	0.35	0.20	0.75	0.70	0.50	0.30	0.35
1½-inch	0.55	0.30	0.50	0.25	0.85	0.70	0.65	0.35	0.40
2-inch	0.80	0.35	0.70	0.30	1.00	0.75	1.00	0.40	0.45
2½-inch	1.20		1.00		1.25		1.50		0.50
3-inch	1.75		1.40		1.50		2.50		0.75
3½-inch	2.50		2.00		1.75		3.50		0.90
4-inch	3.25		2.50		2.00		4.50		1.00

Legend:

H. W. — Heavy wall conduit.

T. W. — Thinwall conduit.

TERMINAL — Any point where a conduit enters an enclosure.

ELBOW — A manufactured elbow completely installed.

FIELD BEND — Bends made in the field. Up to 1-inch use hand tools; over 1-inch use hydraulic bender. Deduct 20% for additional bends of same size made on the hydraulic bender.

JOB NIPPLE — Nipples cut and threaded on job and completely installed, exclusive of special labor such as cutting knockouts, etc.

MFG. NIPPLE — Installation of nipple ordered made to specified length.

Note: Use units for ½ to 1 in. conduit inclusive **only when outlet unit does not cover this additional labor.**

*Previously appeared as Table IV, pg. 52, Electrical Contracting, Sept. 1944.

interest of clarity and completeness, it bears repetition in this evaluation of factors to be considered in estimating conduit feeder installations.

Conduit Supports

We now approach a phase of heavy conduit installation that is of vital importance to the estimator. Too much emphasis cannot be placed on the need for providing sufficient labor to adequately cover installation of supports and fastenings for the conduit system.

In the sample estimate of Figure 1, the labor item for hangers approaches 75 percent of the installation labor for the conduit itself. In some cases, depending on job conditions, this may equal or surpass the actual conduit labor. Many hangers and supports may have to be field fabricated. All this must be carefully considered at the time the estimate is made.

Labor units for conduit supports are applied wherever conduit is fastened to or suspended from the construction. The *conduit unit* (Table I) is for "straight run" unfastened conduit.

To properly apply the conduit support labor unit, it is necessary to consider how the conduits will be installed. In general, a feeder conduit will be installed in one of the following methods:

Direct Fastening — Frequently job conditions will permit fastening the conduit direct to the construction by means of 1-hole cast malleable straps, using expansion shields, toggle bolts, wood screws, etc. On smaller sizes it is common practice to use two hole straps and wood screws.

Suspended—Where smaller conduits must be "swung" below the construction, it is common practice to use a rod fastened by an expansion shield, eye bolt, clevis, or loop. Where conduits are paralleled, a common trapeze hanger, made of two rods and a cross bracket, is generally used.

Concealed—Where smaller conduits are being used in floor forms prior to the pouring of the concrete, or laid across the channels supporting a metal lath and plaster ceiling, there is virtually no fastening labor—the conduits being tied to the steel with tie wire in both instances. This is only true of the smaller feeder sizes. It is not sound engineering practice to install a large conduit across the channels carrying a plaster ceiling. The suspended channel system would not be designed to carry the additional weight of the feeder conduits and cable. In the case of concrete slabs, it is often objectionable to install any conduits over 1¼-inch size in the slabs because of the weakening of structure when the conduits are carried in the beams or slab.

In analysis, *the conduit is figured in straight run* and *any deviations from straight run have separate units.* The conduit labor unit can be applied to the conduit quantity. The conduit terminal unit can be applied to the conduit bushing or the thinwall connector, but it is preferable to enter this as a special labor item as shown in the accompanying sample estimate. The conduit elbow unit can be applied to the elbow quantity. The conduit offsets must be entered under special labor as shown. The conduit nipple unit may be applied to the quantity of nipples; the fastening unit to the material comprising the hangers.

You will note in the sample estimate that separate units are entered for each of the items discussed above and for other items such as pull boxes, panels, switches, etc. The footnotes on the estimate refer to previous discussions of these items. It is imperative that all of these material items are taken off in detail. Exercising care when the estimate is made will pay double dividends. Your bids will be consistent and intelligent. You will have an intimate knowledge of the job which will be of inestimable help when you purchase the materials, make the electrical layout, and are ready to start the job.

Table III
CONDUIT SUPPORTS
Man Hours Each

Conduit Size	Type of Construction			
	CONCRETE	STEEL	WOOD	TILE
	One Hole Cast Straps — Direct Mounting			
	Expansion Bolt	Drill & Bolt or Tap	Nail or Screw	Toggle Bolt
½-inch	0.20	0.25	0.05	0.15
¾-inch	0.20	0.25	0.05	0.15
1-inch	0.25	0.30	0.05	0.15
1¼-inch	0.25	0.30	0.05	0.15
1½-inch	0.30	0.35	0.06	0.20
2-inch	0.30	0.35	0.06	0.30
2½-inch	0.40	0.45	0.08	0.30
3-inch	0.40	0.45	0.08	0.30
3½-inch	0.50	0.55	0.10	0.40
4-inch	0.50	0.55	0.10	0.40
	Clevis and Rod Hangers			
	Expansion Bolt	Beam Clamp	Eye Bolt	
½-inch	0.50	0.35	0.30	
¾-inch	0.50	0.35	0.30	
1-inch	0.50	0.35	0.30	
1¼-inch	0.50	0.35	0.30	
1½-inch	0.50	0.35	0.30	
2-inch	0.55	0.40	0.35	
2½-inch	0.55	0.40	0.35	
3-inch	0.55	0.40	0.35	
3½-inch	0.55	0.40	0.35	
4-inch	0.55	0.40	0.35	
	Trapeze Hangers (Two Rods and 2"x2"x¼" Angle Iron Up to 2-Feet Wide)			
Single Tier	1.00	0.80	0.60	
Double Tier	1.40	1.20	1.00	

Note:

All units based on 12-foot or less working height. Add 5% to above units for each additional foot above 12 feet. (Example: For a 14-ft. height add 10% to units).

LIGHTING TECHNIQUES As Applied To Hospitals

A discussion of the application of basic fundamentals of good illumination for lighting hospitals.

MODERN general hospitals of prewar design had become highly specialized large institutions, requiring broad facilities and expensive buildings. Included in such hospitals were facilities for all types of clinical and nursing services, standard and specialized laboratory work, physical therapy, housing and training of nurses, social service, out-patient treating, and similar functions.

Since 1942, or during the war, hospitals have been constructed primarily by the Army, Navy, Veterans Administration and by municipalities under the program for emergency hospital construction permitted by the Lanham Act of 1941, which provides federal funds to finance emergency health facilities in crowded war communities.

It is expected that local communities, in immediate postwar, will profit from the experiences gained from the construction and operation of these emergency construction hospitals. Priority restrictions on construction forced a radical departure from conventional methods of construction. This made it necessary to set up standards to safeguard the adequacy of hospital service, which was done by the Hospital Facilities Section, States Relations Division, U. S. Public Health Service.

Proper illumination for hospitals, intelligently applied, must be studied and planned for when the hospital plans are in the preliminary stages. It is reviewed here, not only for the benefit of those responsible for the initial planning, but also for the electrical contractor who must later install the lighting fixtures and lighting equipment.

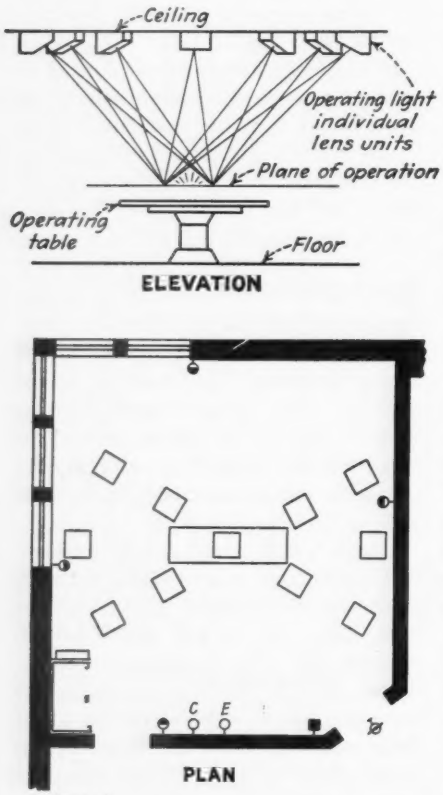
The hospital in effect is an assembly line for medical care. The hospital architect must concern himself with the design of the unit to provide for the smooth flow of patients through it. He must keep in mind the physical comfort and mental serenity of the patient, the problems of seeing faced by the doctors and nurses, the handling of visitors, and at the same time properly relate each facility to provide the maximum efficiency of operation. Proper illumination therefore is of as vital importance as sanitation, safety, heating or ventilation.

In addition to medical care, the hospital patient requires a cheerful atmosphere, quiet, and an absence of any irritating or disagreeable factors. Comfortable glare-free lighting of proper intensity and properly shielded, combined with proper selection of ceiling and wall finishes and interior decorative treatment can do much to soothe the nervous system of the patient, and contribute to rapid recovery.

The lighting requirements for hospitals are many and varied. Some of them are highly specialized, while many are the normal requirements of similar areas in any typical commercial or public building. The principal areas of the typical general hospital can be classified broadly in five groups:

Administrative
Clinical
Nursing
Service
Out-patient

Table I shows a further breakdown of these five areas. Desirable lighting results and lighting techniques which may be used to achieve such results are discussed separately for each type of area.



***LENS OPTICAL SYSTEM** and lighting and electrical layout in one of three major operating rooms, Norfolk County Hospital, Portsmouth, Virginia. An edgeless beam of light is directed to the area of operation by each of the 150 watt lens units of the eleven unit lens system.*

Administrative Areas

A patient receives his first impression of a hospital as he arrives by way of the lobby and waiting or reception room and is directed to the admitting office, unless he is an ambulance or emergency case. The lobby and reception room should therefore have a bright and cheerful atmosphere. Lighting can be used to excellent advantage to form a part of or to supplement the decorative and architectural treatment of these rooms. Cove lighting, or indirect lighting from wall urns can often be adapted. Ornamental semi-indirect or indirect suspension fixtures also will produce a satisfactory solution. If the interior decorative treatment achieves a homelike atmosphere rather than the typical institutional at-

Hospital Areas

ADMINISTRATIVE

PUBLIC AREAS
- Lobby
- Reception Room
- Waiting Room
- Information Desk
- Corridors

OFFICES
- Director
- General Business
- Admitting
- Superintendent of Nurses

LIBRARY AND CONFERENCE ROOM

CLINICAL
- Examination
- Major
- Minor
- Emergency
- Delivery
- Dental
- Surgeries
- X-ray Suite
- Treatment
- Anesthetics Equipment

NURSING
- Sick Rooms
- Wards

SERVICE
- Kitchen
- Dining Room
- Dishwashing
- Laundry
- Lecture and Class Rooms
- Storage

OUT-PATIENT DEPARTMENT

mosphere, indirect torchieres and portable floor and table lamps may be used advantageously. Such portables are frequently used in combination with some type of permanent overhead system of lighting in order to create a feeling of warmth and friendliness. In any system used for these areas all light sources should be concealed, and an average intensity of from ten to fifteen foot-candles of light provided. A higher intensity of lighting may be provided for the information desk by means of a louvered or glass lens unit recessed flush in the ceiling over the desk.

An intensity of from 25 to 40 foot-candles of diffused illumination should be provided for all administrative office areas. The lighting should be free from glare and preferably indirect or semi-indirect. This will permit desks or other office furniture to be properly placed for the most efficient operation without regard to the location of the lighting equipment. Individual type fixtures, either incandescent or fluorescent, usually provide satisfactory illumination on the most economical basis.

The lighting for the library, reading room, reference and conference room should conform with the requirements indicated for office lighting.

Corridors should have only the amount of lighting necessary for safe and easy passage. Corridors adjoining offices or service areas can be lighted satisfactorily with ceiling mounted units, such as flush lens units, enclosing glassware or shallow glass bowl ceiling fixtures, on spacings of from one to one and one-fourth times the ceiling height. Five to ten foot-candles of light are adequate for these corridors. For corridors adjoining sick rooms and wards, low intensity indirect lighting or flush wall night lights are desirable for the comfort of the patients, and permits safe passage by doctors and nurses since their eyes are already dark-adapted due to the low light intensities of the sick rooms.

Clinical Areas

Lighting requirements for clinical areas are radically different from those of any other part of the hospital. In a typical 100-bed small hospital there is usually a minimum of two major and one minor operating rooms. A separate emergency clinic is also desirable. As the size of the hospital increases one major operating room is usually provided for each 50 additional beds, in addition to various special operating rooms, such as dental, labor, delivery, etc., as may be required.

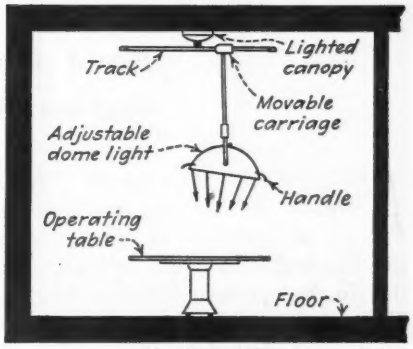
SWIVEL TRACK MOUNTING of adjustable dome light permits universal flexibility of control of lighting for operating tables in De Paul Hospital, Norfolk, Virginia. The dome light is equipped with four 100 watt lamps, and general illumination is provided by 3-75 watt lamps in fixture canopy.

By Berlon C. Cooper

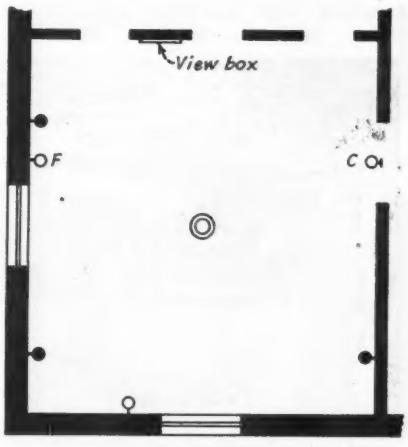
The desirable lighting result for a major operating room is a general level of illumination over the entire room of 20 to 25 foot-candles, plus a high intensity of up to 1000 foot-candles average illumination on the operating table over an area at least 15 inches in diameter where the surgeon works when operating.

There are several lighting techniques and types of equipment which may be used to obtain the desired lighting result. Individual doctors sometimes disagree on the desired type of installation required. Since a surgeon may be operating near the limit of his knowledge, skill and speed, a system of lighting should be employed which will reduce his tension and not annoy him in any way. Some surgeons prefer a fixed overhead lighting sys-

[Continued on page 196]



ELEVATION



PLAN

Legend
- O- Wall bracket outlet
- ●- 3 wire polarized operating room outlet, 5'-0" high
- FO- Fan outlet
- CO- Single face clock outlet
- ◎ Two circuit operating room lighting outlet

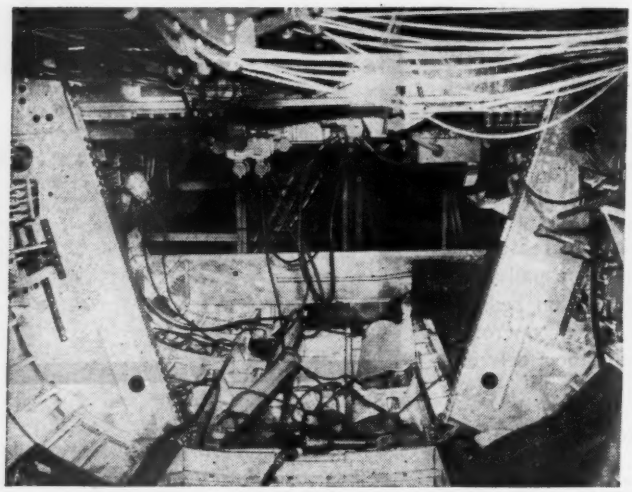
OLD SYSTEM of long extension cords with outlet boxes on floor resulted in heavy maintenance cost and lost time due to broken cords, plugs, tools, etc. This has now been replaced with outlets clamped at readily accessible designated locations.

Power Outlets Speed P

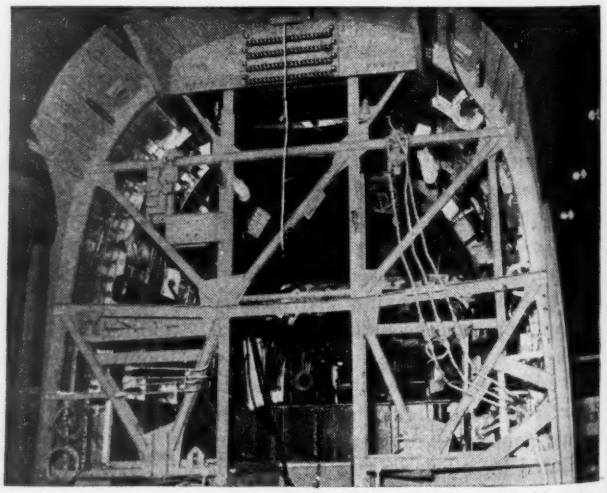
Fixed accessible power outlets on plane sections cut wasted production time 60 percent at North American Aviation's Texas plant.

ADEQUATE illumination, compressed air and electrical power are as essential as aluminum in the building of modern aircraft. At the North American Aviation, Inc. big Texas bomber plant, geared to high speed, high quality production of B-24 Liberators, this indispensable trio must function with top-flight efficiency to meet the army's rigid schedules. So, North American's engineers devised methods of providing the bomber plant's mammoth final assembly department with power service swiftly and economically. Net result was a saving of 20 to 30 minutes per man per shift.

Three types of power outlets are used on the final assembly line: Standard—110 volt, 60 cycle; hi-cycle—350 volt, 250 cycle and air manifolds. Although this is standard practice in aircraft manufacture, the unique feature at North American is the conspicuous absence of unsightly acres of kick boxes, extension cords, lighting fixtures and air hoses.



TANGLED MAZE of extension cords, lights, tools and outlet boxes hampered efficiency of workmen on the interior of the planes. This has been replaced with a new fixed-outlet system.



FIXED OUTLETS using special clamps provide power and lighting facilities in this nose section, eliminating the former welter of cords, boxes, etc. Outlets remain fixed until ship leaves assembly floor.

***NEW SYSTEM** with power and air outlets fixed on wing sections reduces extension cord lengths, keeps outlets and cords off the floor, and provides power outlet at work station. Here, hi-cycle outlets are fed from trolley duct (see arrow) whose trolley follows progress of wing section.*

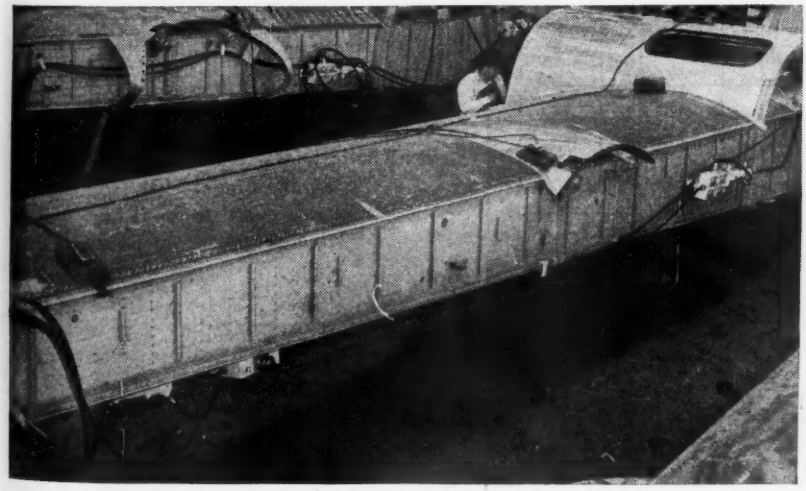
Plane Assembly

By August Eckel

With this kind of tanglefoot system maintenance expenses skyrocket; tools, lines, and power outlets are constantly in need of repair; workers waste precious time working with needed extension cords, hoses and tools in their way. Production speed is seriously retarded due to the confusing disorder.

To eliminate these conditions, North American's industrial engineers designed an assortment of special clamps, brackets and boxes, to fit on various parts of the interior and exterior of the Liberator. These support air hoses, extension cords and outlet boxes during all stages of the ship's construction. A sufficient quantity of these supports and

[Continued on page 119]



***THREE TYPES OF POWER** outlets in fixed positions are on this wing section: Standard 60 cycle on top; hi-cycle and air manifold outlets on front and underside. Special brackets permit quick removal when the ship is completed. Outlets cannot be removed without proper authority.*

***SPECIAL BRACKETS** designed by North American engineers provide the mounting facilities for the fixed-outlet temporary power and lighting system.*

HOW TO USE SHUNT

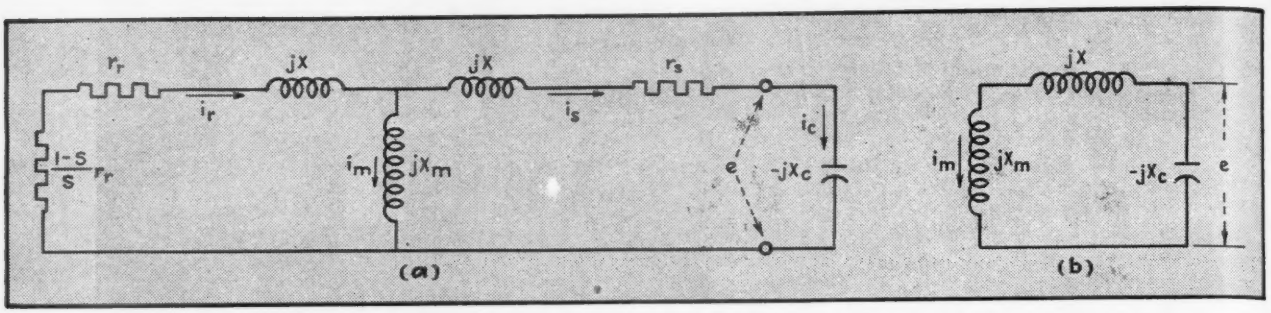


FIG. 1—(a) Equivalent circuit of induction generator with three-phase load of capacitors. (b) Equivalent single-line diagram for no-load excitation condition.

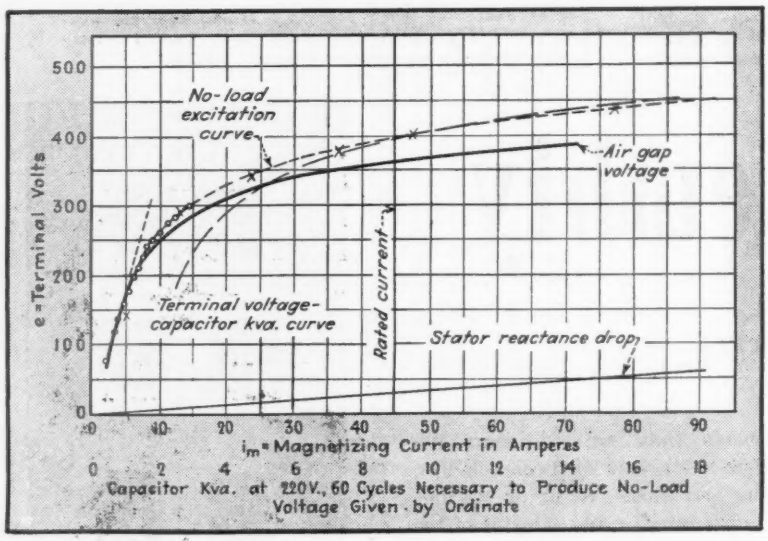

e=Terminal Volts
No-load excitation curve
Air gap voltage
Terminal voltage-capacitor kva. curve
Rated current
Stator reactance drop
i_m=Magnetizing Current in Amperes
Capacitor Kva. at 220V., 60 Cycles Necessary to Produce No-Load Voltage Given by Ordinate

FIG. 2—No load saturation curve of 15 hp., 220 v., 60 cy. induction motor. (Test points: o—motor on a-c line; x—excited through capacitors).

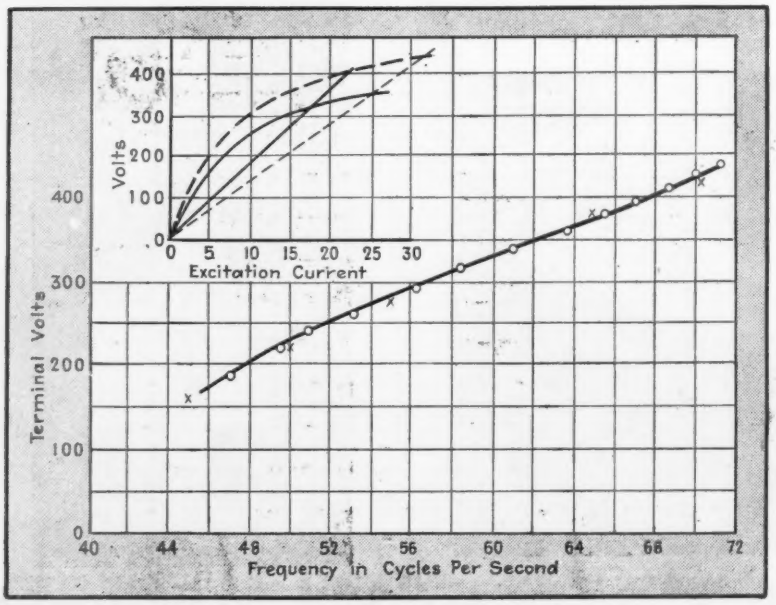


FIG. 3—Effect of change in frequency excited at no-load by 5 kva. 220 v., 60 cy. capacitor. (o—test points; x—calculated).

THE greater percentage of shunt capacitors now installed on power systems are serving to correct the power factor of industrial plant loads consisting of a large number of induction motors. The majority of power companies have incorporated penalties in their rate schedules for customers being served at a low power factor. They are justified in doing so since the distribution of power at a low power factor causes an appreciable loss of current-carrying ability and poor regulation.

Correction of the power factor improves the system performance in four ways:

1. The load-carrying capacity of distribution circuits is increased.
2. Better voltage regulation is obtained.
3. Power losses in the system are reduced.
4. More kilowatt capacity is available.

These benefits are reflected to the consumer's power bill which will be considerably smaller where low power factor penalties are imposed, and also, more power can be taken from the line at better voltage conditions.

The simplest and least troublesome method of correcting a low power factor to a higher value is by using shunt capacitors. If capacitors are added to a system for the express purpose of correcting the power factor, all of the above benefits automatically follow. A consumer making such an installation in order to obtain a better position in the rate structure will find that savings in the power bill will pay for the capacitor in a short time.

Shunt capacitors can be installed at almost any point on a system. It should be borne in mind that only those cir-

T CAPACITORS

By J. E. Barkle
Industry Engineering Department
Westinghouse Electric & Mfg. Co.
East Pittsburgh, Pennsylvania

Power factor correction relieves overloaded transformers and creates additional load capacity where induction motors are used.

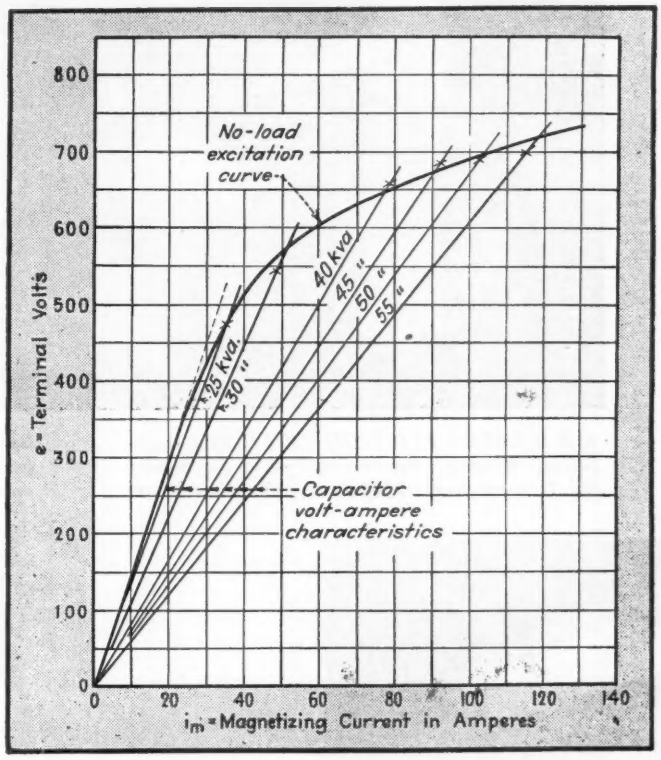


FIG. 4—Excitation of a 50 hp., 440 volt, 3-phase, 60 cycle induction motor by different sizes of capacitors. Test points are indicated by an X mark on the curve.

cuits on the source side of the capacitor bank are relieved of reactive current. In other words, a capacitor acts as a source for the reactive current supplied to a load. Considering a simple radial line from a substation to an industrial plant, if the capacitor is installed at the substation the total current in the line remains unchanged for the same load. Installation at the industrial plant bus will eliminate part or all of the reactive current in the radial feeder, thus, reducing the total current. The current on the load side of the capacitor will be the same as before, that is, will include the reactive component.

There are three methods of installation which can be used in the typical industrial plant:

1. A "group installation" where one bank of capacitors is relied upon to give correction for an entire plant.
2. Several group installations consisting of one bank on each feeder supplying a low power factor load.
3. Individual installation consisting of one or more capacitor units connected directly to the terminals of the individual induction motors.

Precautions have to be taken in installing capacitors by any of these methods. The first two methods are rather simple to analyze, but the last one involves studying the characteristics of the combined motor and capacitor in most cases.

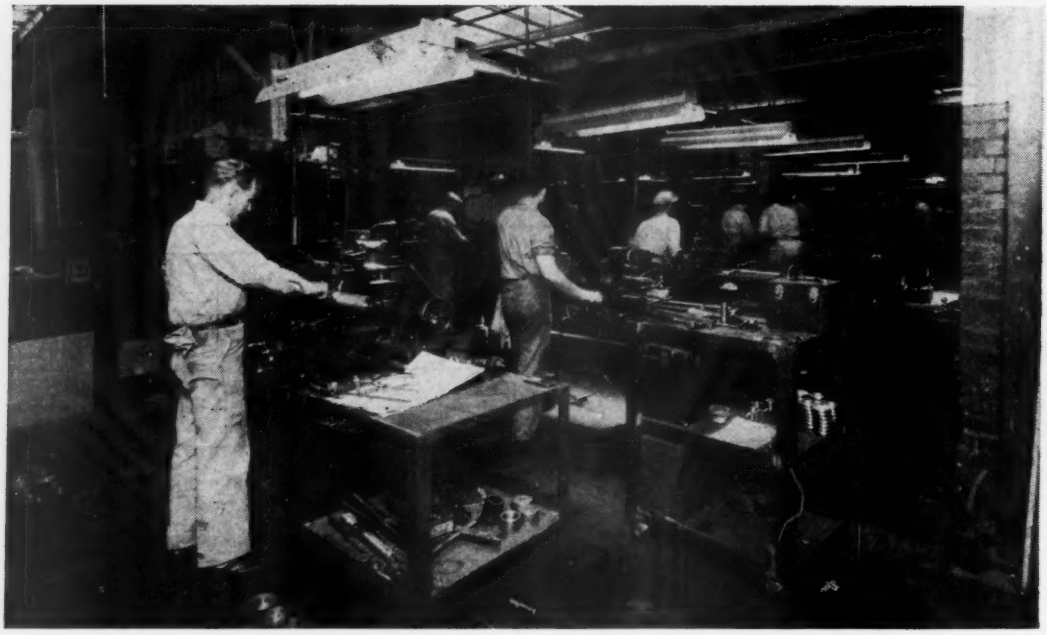
If the industrial plant has a transformer bank on the property, the capacitor bank can be installed in either the primary or secondary leads. A number of factors influence the decision. An installation on the low-voltage side is decidedly more advantageous, since it reduces the total current through the transformer. If the distribution is at 230 volts, a study of the economics may dictate that the installation be made on the primary side, since 230-volt capacitors cost considerably more than 460 or 575-volt units. The items to be weighed against the increased cost of 230-volt units are the increased cost of high-voltage circuit breakers, and whether the releasing of transformer capacity is imperative. If more transformer capacity is needed and the situation will not permit waiting for the installation of a larger transformer, then the capacitor should be placed on the secondary side. The increased cost of switchgear for a high-voltage capacitor will partially effect the increased cost of 230-volt capacitors. Where the distribution voltage is 440 volts or more, the capacitor should be on the low-voltage side of the transformer.

Sufficient kva. must be included in the capacitor to correct the plant power factor to a desirable value. The capacitor kva. is based on a consideration of the plant load and power factor in

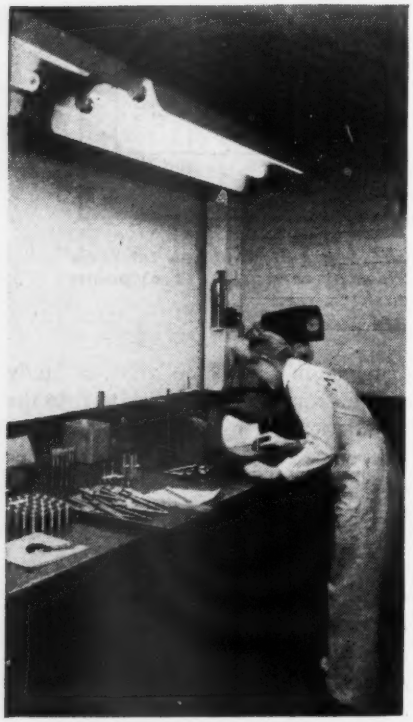
[Continued on page 189]

TABLE I. DETERMINATION OF VOLTAGES BY GRAPHICAL AND TEST METHODS. SUMMARY OF DATA

440-volt Capacitor kva	Line Current I, Amperes	Voltage from Capacitor Characteristics—Fig. 4	Percent of normal voltage	Voltages Obtained From Test	Percent of normal voltage
25	32.8	475	108	475	108
30	39.4	575	131	545	124
40	52.5	650	148	660	150
45	59.1	677	154	685	156
50	65.6	697	159	690	157
55	72.2	720	164	700	159



EACH LATHE IS ILLUMINATED by a twin-lamp, 40 watt, fluorescent unit providing 45 foot-candles of cool, evenly distributed light. Larger machines are lighted by twin-lamp, 100-watt, fixtures. Local lights on each machine provide the "hot spot" needed



***CONTROLLED CONDITIONS** room where close tolerance inspection is done under 100 foot-candles of fluorescent illumination. Inspector is using the special, magnifying type, local light which concentrates 240 foot-candles on the work being inspected.*

Relighting

Rehabilitation of the lighting system, repainting of the plant interior and contrast painting of machinery boosted employee morale and production of precision machine parts in this Houston plant.

ELIMINATION of eyestrain is vitally important to the efficient production of precision machine parts. So, when employees began to complain, the management of the F. H. Maloney Company, manufacturing machinists and tool makers of Houston, Texas, decided to immediately remedy the situation.

After experimenting with fluorescent units, they called on the lighting department of the Houston Lighting & Power Company whose commercial and industrial engineers have been closely cooperating with local contractors in eliminating the lighting bottlenecks in over 350 war-production industrial plants in the area. The recommendations of lighting engineers H. L. Plahn, and W. N. Attaway were closely followed and the plant now has 45 foot-candles of general fluorescent illumination with high intensity localized units for highly precision machining—such as putting two tapers on a ⅝-inch pin.

The old lighting system, consisting of 200-watt incandescent RLM units mounted on 10-ft. spacing, 10-ft. above the floor, was replaced with a fluorescent system consisting of RLM industrial type fixtures, each with two 40-watt lamps, mounted over each machine. The spacing approximates 8-foot centers at a 9-foot mounting height. In some areas the layout took on an asymmetric pattern to permit location of units directly over the machines. Over the larger units, fixtures with two 100-watt lamps were installed.

Localized lighting units are used to give the necessary punch of light needed for high precision work. Mounted on all boring and finishing lathes, these units consist of special assemblies containing two, 6-watt fluorescent lamps and a 5-inch, 3-power magnifying lens which provides 100 to 125 foot-candles of concentrated illumination on the tool point. With this unit adjusted over the smallest type of work, the operator can maintain a high rate of efficient production without suffering eyestrain.

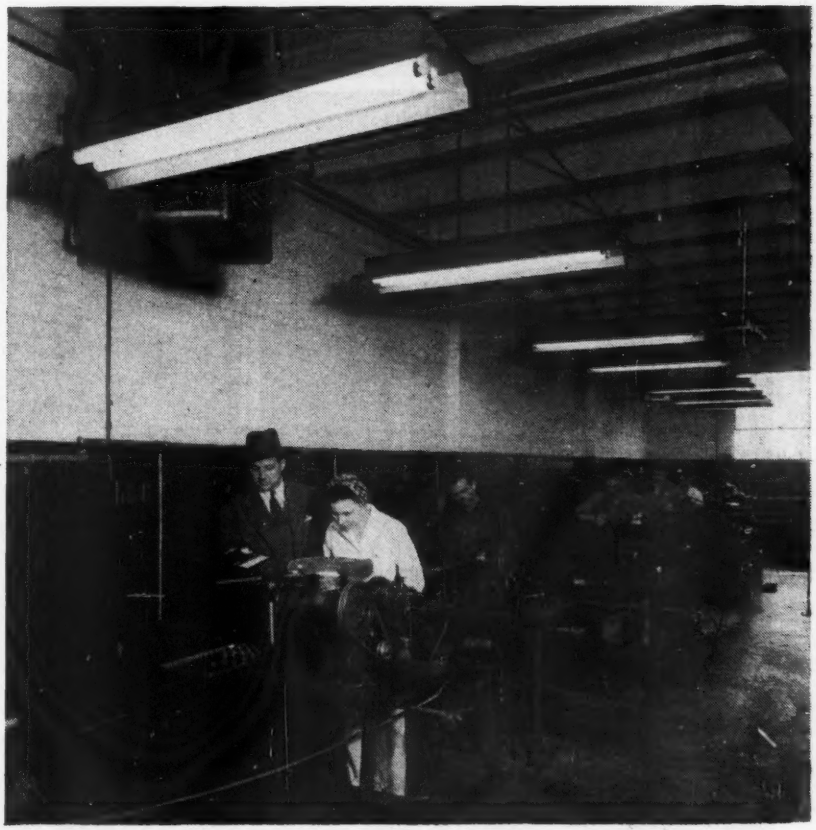
FLUSH MOUNTED, industrial type fluorescent units produce the soft, cool, even light that adds to the pleasant surroundings of this company-owned cafeteria. The modern lighting adds effectively to the clean, efficient layout as a contribution to employee morale.

For Precision Work

Close tolerance inspection, formerly done on a bench in the shop area, is now transferred to a 9-ft. by 15-ft. air conditioned and light-conditioned room. Two, twin-lamp, 100-watt, industrial type fluorescent fixtures provide 100 foot-candles of evenly distributed illumination on the inspection bench. For extra-critical seeing tasks, a special local light equipped with a magnifying lens provides 240 f-c on the work.

Rehabilitation of the lighting system did not end with the installation of the fluorescent lighting. Upon engineers' recommendations the entire plant interior was repainted and the machinery was contrast-painted in a two-tone color to provide three-dimensional seeing for efficient operation. The upper half of the original dull brick and concrete walls are painted a flat white as are the ceilings and supporting structural steel. The lower half of the walls are painted blue.

Reaction to the rehabilitated lighting is vividly portrayed in the management's report that it (1) gives ample light where needed most; (2) provides a "natural" light without glare or shadow; (3) eliminates eye strain; (4) increases the quality and quantity of production with fewer rejects; and (5) provides a cheerful atmosphere.



PRECISION BORING AND FINISHING of minute parts is done under a blanket of fluorescent general illumination. H. L. Plahn, Houston Lighting and Power Company engineer checks the 45 foot-candle general illumination while Miss Lucille Haines uses the fluorescent local light which provides 125 foot-candles of concentrated light on the work.

War KNOW-HOW Makes POSTWAR

Contracting plus specialties in light metals and plating open unusual postwar projects for Omaha's Sterling Electric.

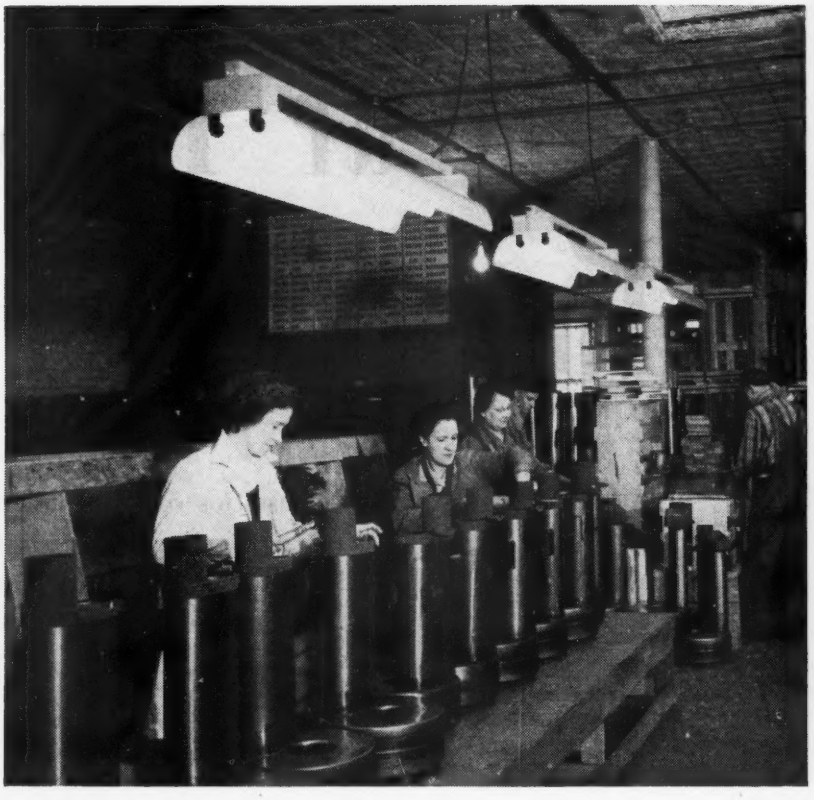
By A. E. Tyler

BEFORE the war, the Sterling Electric Co., Omaha, Nebraska, followed four main lines of endeavor: (1) retailing and servicing small appliances and lighting fixtures, (2) contracting in new construction and remodeling of residences and small commercial buildings, (3) manufacturing of custom made lighting fixtures, traffic signal lights, and some ornamental metal work, and (4) electroplating incident to their manufacturing business.

Came the war, and each department of the company's business was adapted, and in all cases expanded, to fit itself for essential participation in the war effort. The servicing and repair end has more than doubled its volume; the electroplating end broadened its scope

DECORATIVE LIGHTING INSTALLATIONS like this which gave way to war work will be part of postwar reconversion projects at Sterling.

JOBS



***PRODUCTS FOR MILITARY USE** are made in a shop once devoted to fixture assembly.*

***SHEET METAL PARTS** manufactured under war contracts develop specialized know-how applicable to postwar projects.*

considerably beyond the field of strictly electrical appliances. It began to include such items as ash trays, metal vases and urns, silver plate pieces, many of which items are no longer on the market. It was found that personnel trained in working light gauge metals in the fixture and ornamental metal manufacturing department were equally adept at repairing merchandise made of light gauge materials.

Conversions became common. Many customers unable to purchase new lamps are having vases in pottery, metal and glass, converted into lamps. These conversions are grist for the Sterling mill and make up an appreciable part of the doubled "repair" volume.

Under the impetus of available war work, the contracting end of the business has been expanded many-fold. Sterling and two other local electrical dealers combined their contracting departments so that they could participate more effectively in the large government construction projects which have been available. The combination resulted in a more substantial net worth which in many areas has been an important factor in awarding government contracts.

Combination was also the answer to the knotty problem of supervision. The three principal members could each provide experienced supervision for two or more contracting jobs running concurrently and the large volume of work this made possible has simplified purchasing, priorities, and expediting.

Thus armed, the Sterling group has undertaken many large government orders: modification centers for the Martin Nebraska Co., at Omaha; air bases and similar large installations throughout the middle west and south. The expansion of their contracting business under this plan is a military, or at least a trade, secret; but it is obvious that it has been tremendous.

To meet the man-power shortage, the group made a practice of hiring all comers who claimed they were electricians and letting them weed themselves out on the job. Under close supervision the weeding out process has been done very promptly on each project with very little lost time, and has resulted in a picked crew competent to complete work on schedule.

One of the greatest problems has been to get secondary supervisory personnel to streamline their installation practices on a strictly functional basis. From years of peacetime training these supervisors, most of whom were former employees of the three dealers in the combination, were accustomed to arrange even concealed wiring installations in a symmetrical manner—so it would "look nice." Under pressure of wartime schedules they have had to be re-educated in the basic idea that a straight line is the shortest distance between two points, takes less wire and conduit, and requires fewer man hours to install.

Whereas pre-war manufacturing was on a custom built basis in small lots, the company's war contracts call for production line techniques involving large quantities of a given unit. Draftsmen who had formerly designed and detailed lighting fixtures and ornamental pieces are now designing jigs and fixtures for the production line and detailing working-drawings of the war necessary items.

At first, Sterling made independent

[Continued on page 183]

War Presses Industry Progress

Necessities of war have fostered swift advance in electrical design and application. Engineers exchange knowledge and know-how gained from wartime experience at AIEE winter technical meeting.

WAR requirements have moved the entire electrical engineering front swiftly ahead during the past year. Technical papers representing a good cross-section of the industry revealed quite a dramatic story of progress at the recent winter technical meeting of the American Institute of Electrical Engineers held in New York City.

Electrical designs and applications to the implements of war were discussed as well as those to industrial and utility plants. Several sessions were devoted to discussions of plant distribution design and construction. Insulation developments which will certainly have effect on equipment rating in the future were revealed in several papers. Another paper dealt with an insulation resistance measuring instrument which can apply d-c test voltages to circuits up to 200,000 volts. Supervisory control, calculation of fault currents, three-wire service from ignitrons, power distribution for arc-welders and application of capacitors to induction motors were a few of the many subjects discussed.

The following abstracts highlight the more important presentations to the construction and industrial fields, and complete papers can be obtained from AIEE headquarters at 33 West 39th Street, New York, New York, at a nominal fee.

Modern Electric Power Distribution Ideas As Applied in a Large War Plant

Reliability of electric service is incorporated in the form of the secondary selective arrangement in which each individual load circuit has access to an alternate independent source of low tension power.

Effective duplication of electric service is carried through to the incoming 115-kv. supply system. The two coordinating primary feeders at each and every substation originate from different 13.8-kv. buses. Both of the latter in turn may be energized by either or both main transformers and (should a second 115-kv. feeder be added) from either or both incoming high-tension lines.

Supplying general purpose power and light to the main factory are sixteen load-center unit substations aggregating 30,000-kva., representing about 13.3 volt-ampere per square foot of working floor space.

The substations are installed in enclosures forming a part of the ventilating fan houses located on the building roof. The reasons for this selection are: 13.8-kv. feeder cables are supported on racks close to the building roof; the bulk of the power is distributed to plug-in bus also located closer to the roof than to the floor; and the fact that the enclosures could be integrated with houses there located for other purposes.

Both power and light are served by common load-center unit substations using a 460/265, four-wire, grounded neutral system to supply 440-volt polyphase motors in the normal manner and 265-volt fluorescent lighting units from line to neutral potential. Plug-in bus is used to distribute power to the major portion of the load consisting of distributed machine tools so as to obtain the needed flexibility to accept fairly frequent rearrangement of machine tools for production efficiency improvement or changed requirements.

To avoid operation at undue temperature on the plug-in bus, should the load be badly disproportioned among the four radial extensions, a temperature alarm (including bell and lamp) is installed adjacent to the feeder tap on each bus section which will sound an alarm upon reaching an 80°C operating temperature. Each power feeder consists of three single-line conductors plus one bare neutral conductor, which conductors are symmetrically spaced by means of trisected porcelain support blocks. Individual conductors are kept taut by straining them in the horizontal direction to structural members of the building.

An ingenious innovation is represented by the suspension of a series of fluorescent units from an overhead messenger cable. A single No. 12 conductor, in combination with the messenger as a ground return, serves a 4-kw. lighting load.

About 10,000-kva. in capacitors have been applied to the 480-volt distribution system, in 90-kva. blocks directly adjacent to the feeder tap in the plug-in bus.

Except for circuits leading to the boiler house, the 13.8-kv. cables are supported on wood lattice racks or troughs suspended from the building roof above the level of the illumination fixtures. Practically no advance preparation of building structure is needed. Cables are easily pulled into place. In the present instance, full reel lengths of 1000-ft. were pulled into place without the slightest difficulty. To assist in

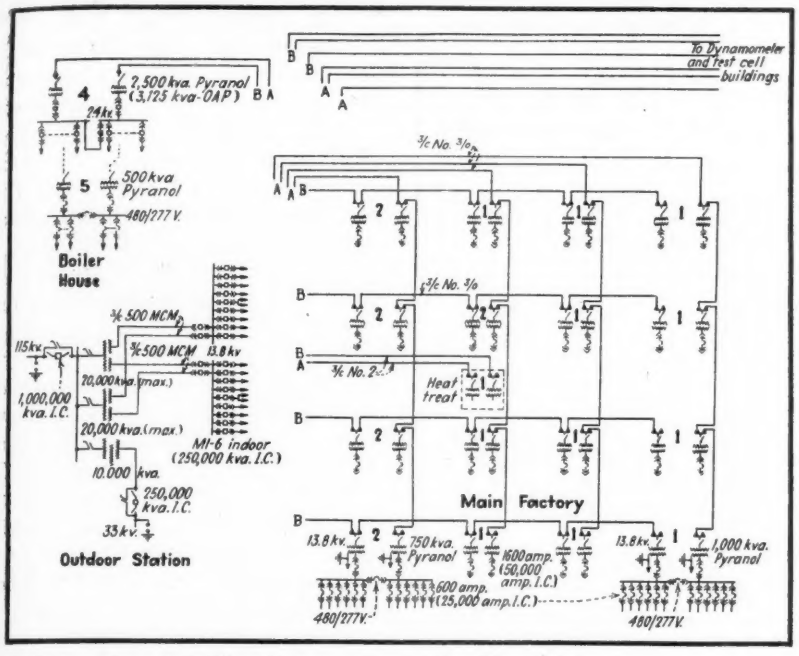


FIG. 1—Electrical Distribution System One-Line Diagram

pulling around corners, a jig was prepared which forms a 24-inch radius arc, around the periphery of which a number of wood rollers were arranged. By temporarily clamping this jig at a corner, the cable was swung around a 90-degree turn with a very small amount of drag. Splices can be made at any spot along the trough. Cables are cut only when a point of termination is reached. The entire length of cable is accessible after installation. Repairs can be made with no waste of cable and without disturbing any section of the cable other than a damaged portion. Permissible current load levels are no less and may be greater than those permitted in underground runs.

Application of Capacitors for Power Factor Improvement of Induction Motors

Power factor improvement of induction motor loads by means of shunt capacitors has been a common practice for many years. Recently, the practice of connecting the capacitors directly at the motor terminals has developed, in order to permit switching of the capacitors and motor as a unit. This will not result in adverse motor operation if the amount of capacitors is properly selected.

Experience has shown that frequently too large a capacitor was used resulting in overvoltage due to self-excitation when the motor starter was opened (Fig. 2). In several cases, the motor coupling and shaft were damaged when too large a capacitor bank was used and the motor switched by a reduced-voltage auto-transformer type starter. In some cases, motors have been damaged from overload because allowance was not made in the overload setting for the reduction in line current due to the capacitors. In other cases, instruments and meters connected in the current transformer secondary circuit have been damaged due to overvoltage.

When capacitors are connected to the motor terminals, they supply some of the motor-magnetizing requirements, so the actual line current is less than it would be without capacitors. If the capacitors are connected to the motor starter on the load side of the thermal overload device as shown in Figure 3, the overload relay will not provide proper protection to the motor if it is selected for the uncorrected motor full load current. The relay should be selected for a smaller current rating commensurate with the reduced line current due to the effect of the capacitors.

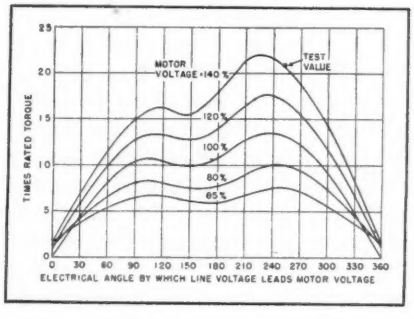

MOTOR VOLTAGE +140 %
TEST VALUE
120 %
100 %
80 %
65 %
TIMES RATED TORQUE
0 5 10 15 20 25
0 30 60 90 120 150 180 210 240 270 300 330 360
ELECTRICAL ANGLE BY WHICH LINE VOLTAGE LEADS MOTOR VOLTAGE

FIG. 2—Peak electrical torque versus switching angle.

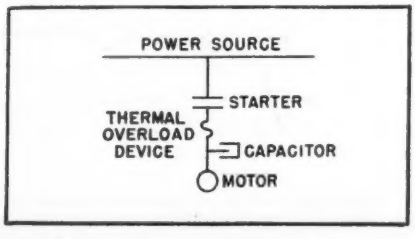


FIG. 3—Location of capacitors and thermal overload relay.

Several studies were made to determine the relative economics of plant power factor improvement by means of capacitors with individual motors and the group capacitor method.

Generally, economic considerations favor the group capacitor installation for plant power-factor improvement when the service voltage is below 600 volts, the individual motors are small, and the motor diversity factor is large. For other conditions individual comparisons should be made. For maximum operating benefits the group capacitor method will usually consist of several blocks of capacitors automatically switched.

Graphical Method of Calculating Fault Currents on Rural Distribution Systems

In the application of fuses, oil circuit reclosers, or any other type of sectionalizing device on a distribution system, a considerable amount of time and effort is usually spent in calculating fault currents at various locations on the system. The purpose of this paper is to describe a graphical method of calculating the fault currents which simplifies the task of making the calculations. The advantages of the graphical method, over other methods commonly used to make fault-current calculations, are:

1. A visual picture is obtained of the possible fault currents at any location on the system.
2. There is less chance for error.
3. Considerable time and effort are saved in making the calculations.
4. A compact permanent record is obtained.
5. It provides an easy method of quickly calculating the fault currents on new extensions added to the system after the original fault-current study has been completed.

The graphical method outlined in this paper is an exact method of calculating the fault currents. The accuracy obtained depends upon the scale chosen for the calculation diagrams and the care taken by the person making the calculations.

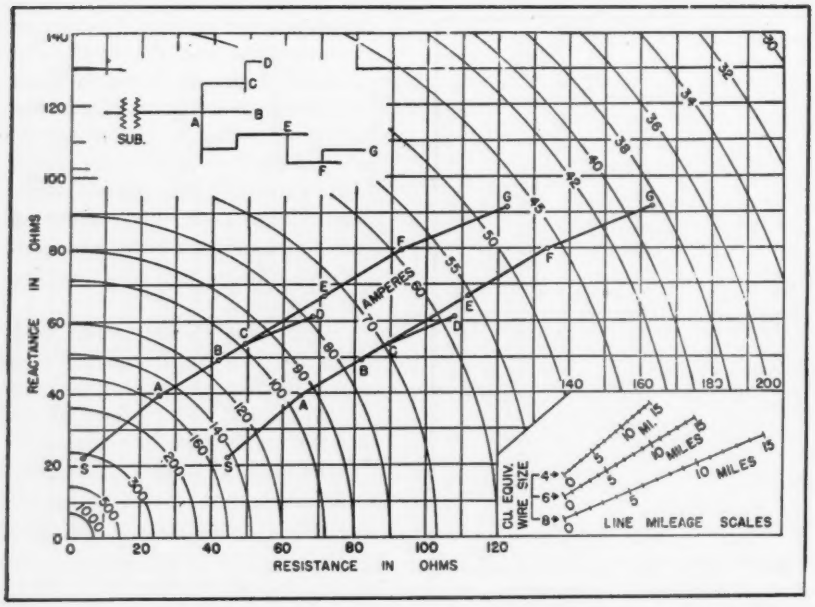


FIG. 4—Illustrative example showing one-line diagram of a 7,200/12,470-volt system and graphical calculation of line-to-ground fault currents. Calculations above the current scale are for maximum fault currents and calculations below the current scale are for minimum fault currents.

Line-to-ground, line-to-line, and three-phase types of faults are considered.

Fault-current calculations are made on current diagrams which are designed for a specific system voltage. A separate current diagram is used for line-to-ground, line-to-line, and three-phase faults. A typical current diagram is shown for use on 7,200/12,470-volt multigrounded-neutral system. The current diagrams are exactly the same except for the line-mileage scales.

In using the current diagrams for determining the fault currents on a distribution system, the starting point is at the source end of the system which is usually the load side of a substation feeding the system. It is necessary to know the equivalent total resistance and total reactance of the system from the generators to the starting point of the distribution system, for the type of fault being calculated and for both maximum and minimum fault-current conditions. All resistance and reactance values must be referred to the voltage base of the current diagrams.

The procedure for calculating fault currents on the current diagrams is as follows:

1. Locate the point for the equivalent total impedance of the source and distribution substation by laying off the resistance along the horizontal scale and the reactance along the vertical scale. Locate the total impedance for both maximum and minimum fault-current conditions. Read the fault currents on the circles.

2. Draw a line from the points located in step 1 to the right, parallel to the line-mileage scale for the conductor size in the first section of line away from the substation.

3. Using a compass, or dividers, and the mileage scale for the proper conductor size, set the instrument to the number of miles from the substation to the first point out on the system where it is desired to know the fault currents. Lay this distance off from the points located in step 1 along the lines drawn in step 2.

4. Read the fault currents.

5. Repeat the above procedure for the next point farther out on the system where it is desired to know the fault current. If the conductor size on the line changes, draw a new line on the diagram from the point for the end of the first conductor size, parallel to the proper mileage scale. Repeat until all points on the system, at which fault current values are desired, have been plotted on the diagram.

Power Supply for A-C Welding

This paper presents data useful for determining the effects of a-c arc welding loads on electrical power circuits.

High reactance, transformer-type, single-operator welders are almost universally used for a-c welding. They are two-winding transformers, not auto transformers for obvious reasons of safety. A-c arc welders are rated in terms of welding amperes rather than kva.

The arc welding duty cycle varies widely, not only from plant to plant, but also from hour to hour in the same plant. (In this paper the term "duty cycle" will mean a group of specified intervals of arc time and idle time; for example, five minutes on and five minutes off. Duty factor is the ratio of arc time to the total time under consideration.)

Basically, the usual manual arc welding duty consists of about one to one and a half minutes under load, followed by ten to fifteen seconds idling, resulting in a short time duty factor of 80 to 90 per cent. However, this cycle is rarely repeated more than eight or ten times before a longer idling interval takes place, so that all-day duty factors may run as low as 10 percent, or as high as 50 or 60 percent, depending on the nature of the work.

Advantage may be taken of these facts when providing electric service for groups of arc welders. Table 1 lists a conservative method of calculating primary line capacity to supply a group of welders.

This table is usable for either low power factor welders or power factor corrected welders, using in either case the actual primary current when delivering rated welding current. Wiring according to this table will carry without being overloaded the current from 50 percent of welders operating at full load and 50 percent of them idling when low power factor welders are used, and will carry the current from 60 percent of the welders at full load and 40 percent idling when power

[Continued on page 186]

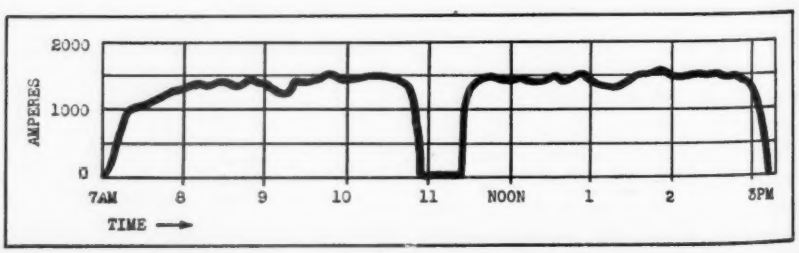


FIG. 5—Arc welding current load drawn by 35 operators of a group averaging 160 amp. each. Indicated average duty factor 25 percent, demand factor 26 percent. Peak demand 1700 amp. (30 per cent).

EXPLOSION-PROOF Wiring

Complete explosion-proof installation includes fool-proof grounding system for portable equipment.

Fig. 1—*BANK OF MOTOR SWITCHES* for pump and fan drives. LB fittings carry both line and load circuits of magnetic breaker mounted on other side of wall. Sealing fittings are used at each switch.

THE explosive atmosphere generated by paint spray operations require electrical systems to be enclosed in explosion-proof fixtures. In the recent construction of a new process building for a western New York aircraft plant, the entire electrical distribution was made explosion-proof since the major activity was to be paint-spraying. The several other process operations involved only a minor portion of the building area, and explosion-proof wiring obviated the use of partitions that otherwise would have been required. The electrical work was done by Schaeffer Electric Company, Warren, Pa.

Power equipment is served by 440 volt three-phase circuits fed from a load center substation just outside the building wall and near the corner of the building where most of the motor load is concentrated in pump and fan motors. The pump motors are used in the paint spray system for generating pressure to move the paint, while the fan motors are mounted near the ceiling in the ventilating ducts.

A bank of motor switches is shown in Fig. 1 for the control of two pump motors (one 10 hp. and one 15 hp.) and 5 hp. fan motors. The six three-phase circuits leave the pull-box (mounted on the brick wall) in separate conduits and pass through sealing fittings before entering the explosion-proof motor switch housings. Load circuits first pass through the wall to the magnetic circuit breakers (non-explosion-proof) and come back into their respective switch housing (through the same conduit and fittings) and then continue to their loads. Sealing fittings are also used on the motor runs, both at the switch housing and at the motor. Explosion-proof motor housings were of course also used.

Grounding receptacles like the one shown in Fig. 2 were installed on various columns to facilitate the grounding of portable equipment. Two-pole 30 ampere receptacles were used for this purpose with each pole connected to separate interconnected grounds. No. 6 bare stranded copper wire in half inch conduit was used as grounding circuits,—one tied to driven grounds at either end of the building,

Fig. 2—*GROUNDING RECEPTACLES* for portable equipment are shown here. Both poles are tied to separate interconnected grounds. Lighting circuits terminate in panel (not installed) through sealing fittings.

and the other tied at two points to the cold water main. The driven grounds and the water main were then connected to provide an adequate as well as a fool-proof grounding system.

The other circuits shown on the column in Fig. 2 terminating through four sealing fittings are for the 120/208 volt lighting circuits (panel not yet installed at time photo was taken). General illumination is provided by 300 watt explosion-proof fixtures spaced on eight foot centers at about a 14 foot mounting height.

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

PRACTICAL METHODS

BULK PLANT WIRING GUARDS AGAINST EXPLOSION HAZARDS

By WM. W. GRUENER
Booma-Gruener Electric Co., Inc., Hartford, Conn.

WIRING

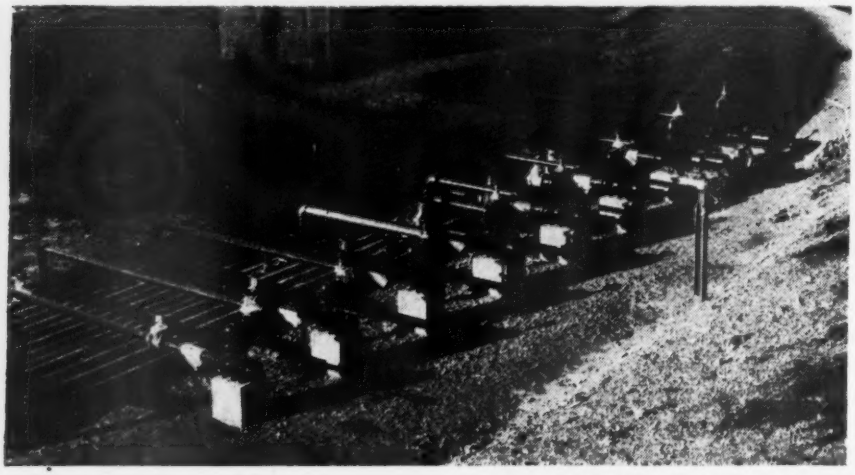
In providing for electric service at the Hartford, Conn., Bulk Plant of the Socony Vacuum Oil Co., plans to insure an explosion-proof and highly flexible installation were made well in advance of construction. The requirements of such a layout call for much more definite planning than occurs in an ordinary industrial job. In this class of work it has been determined by the National Board of Fire Underwriters and manufacturers who have made exhaustive tests in the field that it is unreasonable to expect that explosive vapors always, under all circumstances, can be prevented from entering explosion-resistant devices. Hence such devices must be designed (1) to keep explosive gases out of the system, and (2) that if and when such gases do enter and an explosion occurs as a consequence, the walls and covers of such devices are so constructed as to confine the explosion entirely within the device where it occurs.

In this plant 2-phase, 4-wire energy is delivered to the property by the Hartford Electric Light Co. In order to provide a power supply which would accommodate the more readily obtainable 3-phase motors desired for the installation, a Scott-connected transformer was provided on the property and located in a building in the so-called non-explosion area near the service entrance. A 200-amp. remote-controlled magnetic switch enables the entire power supply to the plant to be quickly cut off if desired, this switch being operable from two conveniently located emergency pushbutton stations, one on a truck loading platform and the other at the main switch panel of the plant.

The main panel controls eight explosion-proof pump motors which are installed in a single row on concrete bases. Pumps and motors are mounted well above the ground for avoidance of moisture, and provide highly flexible facilities for the handling of liquids between tank cars, storage tanks and connecting pipe line by arrangements.

The main control panel or supporting rack (9 ft. by 14 ft. with 1½-in. by ¼ in. strap frame) carries eight manually operable disconnect switches with remote controlled magnetic switches mounted directly under each disconnect switch. These magnetic switches are controlled from 34 push-button stations on the grounds, 16 being located on truck loading platforms and 18 on the railroad sidings. All wiring between pushbutton control stations and the main panel, as well as that from the panel to the pump motors, is installed in underground conduits. The magnetic starters are of Trumbull make and are of the explosion-proof type. Main junction boxes are of Crouse-Hinds make, and this company also manufactured the sealing fittings which were used at all points where the code requires such protection against the travel of explosive vapors through the conduits of the system. All conduit and threaded connections of fittings were thoroughly leaded before making them up. A 200-watt vapor-proof lighting fixture was installed directly above the center of the switch panel to give illumination for night operations and possible service requirements.

Various colored pilot lights were mounted high enough above the roof back of the main control panel rack to be readily seen from any of the remote-control pushbutton stations on the property. The switches on the panel are installed numerically in relation to the motor each controls, and the pilot lights above identify the product being pumped. The pilot lights and fixtures above the roof are of vapor-proof but not explosion-proof design, as those in authority agreed that they are mounted above the explosion area. All lighting fixtures on truck loading platform space, however, were made explosion-proof in view of the very heavy gas vapors found in such areas.



BATTERY of motor pumps serving oil lines in yard. All electric wiring in plant is in underground conduit.

TRAINING AT SCINTILLA MAGNETO DIVISION OF BENDIX

By LYNE S. METCALFE

TRAINING

Perhaps no phase of wartime production has made greater progress in devising effectual methods of personnel training than has electronics. Not only is this true in electronics engi-

[*Advertisement*]

SYLVANIA NEWS

CONTRACTOR EDITION

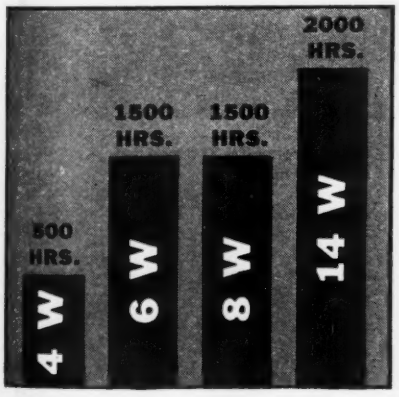
MARCH — *Published in the Interests of Better Sight and Sound* — 1945

SYLVESTER SURVEY

I said—"Would fluorescent lighting make your work easier?"

NEW LIFE RATINGS FOR FLUORESCENT LAMPS

Sylvania Electric announces new life ratings for miniature and 14 watt fluorescent lamps. Since these lamps will be most commonly used in home lighting, the ratings were determined, under specified test conditions, for a 3-hour burning cycle which closely approximates normal home use.



New life ratings have also been announced for Sylvania Blacklight lamps (linear sources of near ultra-violet).

Contractors Find New Maintenance Service Profitable in Many Ways

Sylvania Fluorescent Service Plan Increases Business; Builds Good-Will

Enthusiastic reports are being received from electrical contractors who are finding the new Sylvania sponsored fluorescent maintenance plan a ready-made source of additional income. This plan is based on the furnishing of complete fluorescent maintenance service to the user.

HOW PLAN WORKS

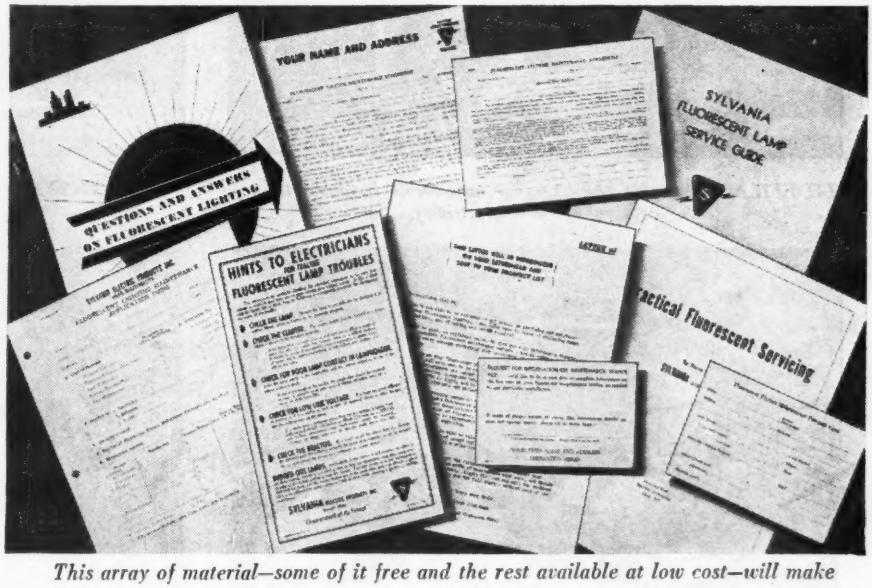
Under the plan, qualified contractors in every territory are backed by Sylvania's technical assistance and business helps, making it easy for contractors to furnish stores, offices and other commercial establishments with a complete fluorescent maintenance service. Contracts are offered on a low monthly rate basis.

Sylvania supplies the contractor with the latest maintenance data and with all the necessary contract forms and record sheets needed to set up the service.

ADVANTAGES

The Sylvania maintenance plan offers contractors four distinct advantages:

1. Direct profits from a whole new field made easy to enter with Sylvania's help.
2. Favorable contacts with fluorescent users, opening the doors to sales of larger installations.
3. An outstanding opportunity to build up prospect lists for the sale of other services and merchandise.
4. A powerful sales aid in approaching new prospects for fluorescent lighting installations.


YOUR NAME AND ADDRESS
QUESTIONS AND ANSWERS ON FLUORESCENT LIGHTING
HINTS TO ELECTRICIANS ON TROUBLES FLUORESCENT LAMP
SYLVANIA FLUORESCENT LAMP SERVICE GUIDE
Practical Fluorescent Servicing

This array of material—some of it free and the rest available at low cost—will make it easy for contractors to set up a profitable fluorescent maintenance program.

SYLVANIA ELECTRIC

SYLVANIA ELECTRIC PRODUCTS INC., Salem, Massachusetts

MAKERS OF FLUORESCENT LAMPS, FIXTURES, ACCESSORIES; INCANDESCENT LAMPS; RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES

neering, but also in the field of electrical equipment and unit production. Advances have been especially marked in the adaptation to and integration of visual aids, with other forms of instruction, manual study, lecture, shop practice and shop demonstration.

However, a large majority of the products of electronics today are of the type which call for skill in installation, maintenance and repair; and in this field, training usually is as important as in the production of the units themselves.

An interesting example of the progress made in this direction is found in the service training schools of the Scintilla Magneto Division, Bendix Aircraft Corporation, at Sidney, New York.

It may be said at the outset, that the modern aircraft magneto is a complicated piece of equipment, containing several hundred parts, machined to very fine tolerances, and that even assembly or disassembly is no "ten minute job". That is why the Division has undertaken, with signal success, to devise a comprehensive service mechanic training program which in principle, would as easily apply to any product of electronics needing care and repair.

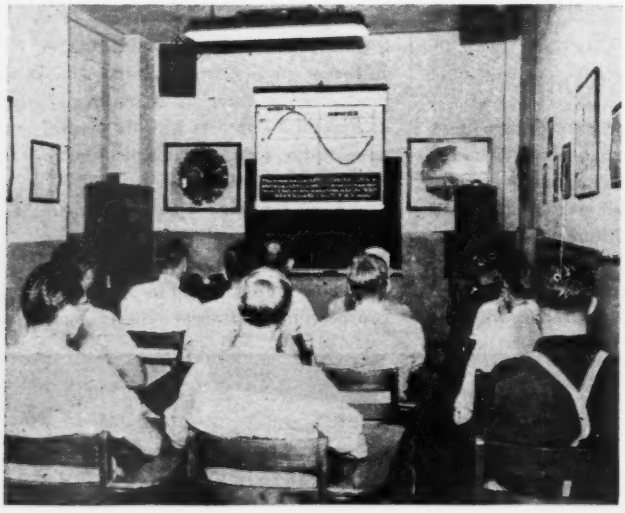
The Scintilla factory schools utilize what often has been referred to as "vestibule training system," which includes the special use of visuals in the form of sound motion pictures and discussional type slidefilms. But, the films are used as supplementary aids to other forms of instruction, and serve a very definite and important purpose.

So successful has this program proved to be at the Division's plant, that arrangements have been completed to make the teaching material available to any aeronautical school, airline, aircraft or aircraft engine manufacturer with a magneto servicing problem. The Jam Handy Organization, Detroit, produced for this program a series of 17 discussional type slidefilms, covering about 15 of the Division's most widely used aircraft magnetos. Such subjects are visualized as installation, timing, wiring, and checking inspections, and maintenance in service, assembly and disassembly, test procedure, inspections, etc.

One feature of particular interest is the manner in which safety practices and safety precautions have been interwoven with the instructional material contained in the films. By this system, the student learns how to do things *safely* at the same time that he learns to do them *right*. An example: if certain magneto wires are left connected on the magneto while the mechanic is working on it (on ship), a slight movement of the prop might start the engine, even though the magneto itself is partially disassembled.

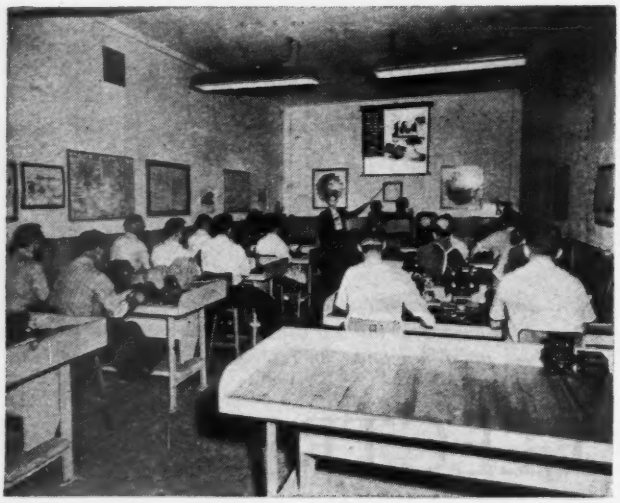
Another feature is that the instructor is equipped with a chest microphone, connected with the classroom PA system, which frees his hands for using the pointer, and saves wear and tear on his voice.

Students for these service classes, upon arrival at the plant, are formed into groups or classes of about 30. They

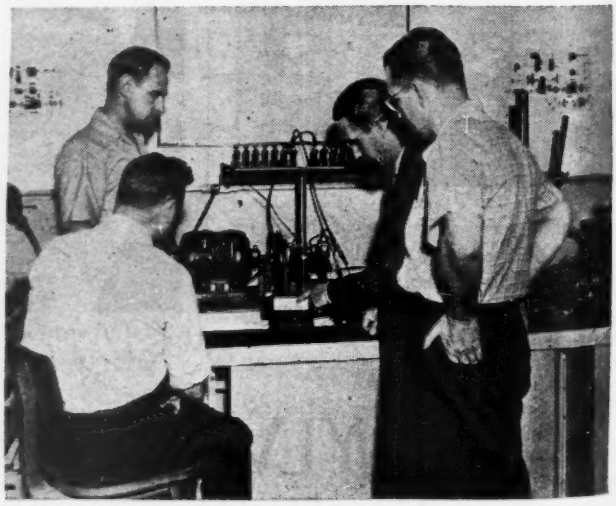


***SLIDEFILMS** help give the beginner an overall fundamental conception of basic electricity.*

***THE INSTRUCTOR** comments with the aid of a chest microphone.*



***STUDENTS** follow procedure patterns on the screen as they overhaul equipment.*



***AFTER THE OVERHAUL**, each unit is tested and meter-checked by the instructor.*

CONDULETS

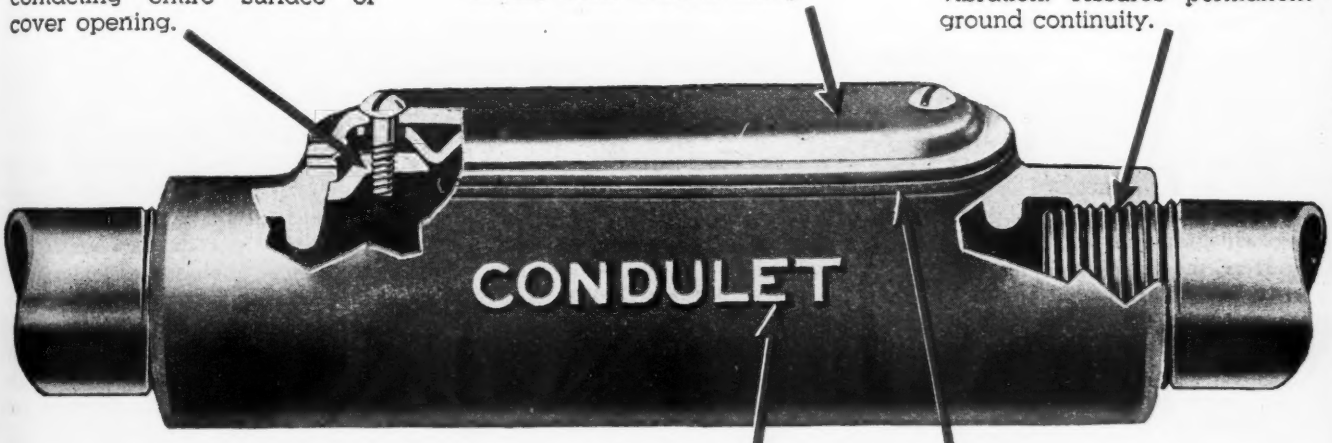
are made only by CROUSE-HINDS

The Crouse-Hinds Company introduced the first cast electrical conduit fitting that was ever manufactured. Identified by the Crouse-Hinds trade name, **CONDULET,** this fitting was so well designed that it quickly revolutionized electrical conduit installation practice. Today, the complete CONDULET line, greatly expanded and improved, is still the Standard of Quality in the field of electrical conduit fittings.

The WEDGENUT fastener, an exclusive Crouse-Hinds feature, is part of the cover. Screws can't fall out. No screw holes to locate. When tightened by the WEDGENUT fastener, the cover automatically seats itself, firmly contacting entire surface of cover opening.

The Obround CONDULET was the original cast electrical conduit fitting. Today's improved CONDULETS have quality features not found in any other conduit fitting.

Taper Tapped Threads, an important Crouse-Hinds feature. The threads on tapered conduit bear against every thread in the hub of a taper tapped CONDULET. This provides the most rigid joint, not affected by vibration. Assures permanent ground continuity.



CONDULETS are made only by Crouse-Hinds and every genuine CONDULET bears the Crouse-Hinds trade name, **CONDULET,** or the Crouse-Hinds trade-mark.

When a gasket is used, you have a thoroughly **Weatherproof** enclosure.

Obround CONDULETS are a large and useful Series in the big CONDULET family. There are **49** different Obround Types listed in CONDULET Catalog No. 2500, Section 5. Sizes to fit ⅛" to 6" conduit. Three styles of hubs: for thick wall threaded conduit; for thick wall threadless conduit; for thin wall threadless conduit (electrical metallic tubing). In addition to plain covers, a variety of wire hole, switch, and receptacle covers are available.

A Nationwide Distribution Through Electrical Wholesalers

ARMY E NAVY

CROUSE-HINDS COMPANY
SYRACUSE 1, N. Y., U.S.A.

Offices: Birmingham—Boston—Chicago—Cincinnati—Cleveland—Dallas—Denver—Detroit—Houston—Indianapolis—Kansas City—Los Angeles—Milwaukee—Minneapolis New York—Philadelphia—Pittsburgh—San Francisco—Seattle—St. Louis—Washington. *Resident Product Engineers:* Albany—Atlanta—Charlotte—New Orleans
CROUSE-HINDS COMPANY OF CANADA, LTD., *Main Office and Plant:* TORONTO, ONT.

CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

are, first of all, given a fundamental understanding of electricity with the help of the slidefilm series, "Basic Electricity". It has been found that an understanding of basic electricity is important because the magneto itself is a special form of alternating current generator, and the basic slidefilms get across theory more quickly and without confusing details.

CLASS PROCEDURE: following the basic electricity lesson, the group gets a first insight into the operation of a modern aircraft magneto system. For this, slidefilms produced for the purpose are used as teaching aids. The instructor pictures (on the screen) and explains the differences between the various types of magnetos, maintenance procedures, and variations.

Once the class has seen what is *inside* the magneto, it receives preliminary impressions of overhaul procedure, and the use of special tools *before* starting workshop projects. This, it is said, saves much time later at the classroom workbenches.

Benches are provided in the Scintilla class-room workshops, each equipped with service tools. Operational slidefilms are repeated while the class follows, step by step, procedures on the magneto units lying before each man on the bench. (The school also has a complete array of instruments, oscillograph, testing equipment, etc.) Here, the proper and approved method of each operation is pictured on the screen and followed at the bench. This method, it is pointed out, keeps the students away from possible pitfalls of incorrect procedure which might otherwise occur if each man were left to work things out for himself.

Later, there are question and answer periods, with general discussion. And any steps which the trainee may have missed are now repeated—using supplementary wall charts, diagrams and sketches to help settle arguments and clarify points.

After the overhaul, each unit handled by a student is put to the test, the instructor using a meter to check the output of the individual overhauled magneto. Such testing shows the class any errors, spurs interest by creating a spirit of competition, and helps the men understand "trouble-shooting".

It will be seen that the principles of combining films with shop or bench-work practice may easily be applied to service instruction on almost any electronics product that is subject to periodical servicing—care and repair. The films have the effect of giving unity to each class or session as well as to the entire course. They also provide a simplified teaching procedure previously approved. They keep the procedures "on the track", and give each of the 30 students an identical visual procedure pattern to follow.

The decision to make these films available to any aircraft magneto servicing operation, aeronautical school craft or aircraft engine manufacturer, suggests a type of "extensional" educational program which probably will be widely adopted in the electrical field from now on.

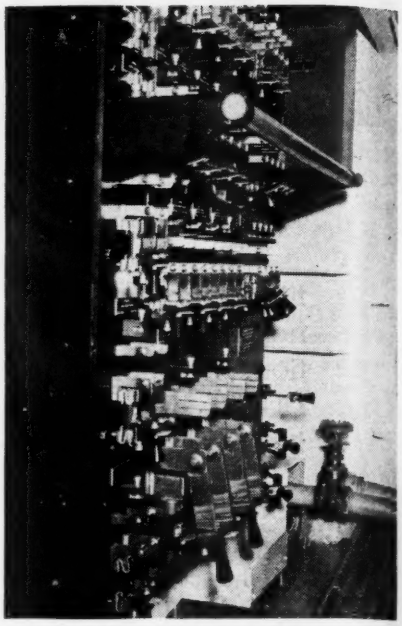
The Scintilla program offers a good example of the lesson learned in this war about teaching films—it is not enough to merely *show* them—they must be *used*.

MOTORS USED FOR PRE-OILING TESTS

INDUSTRIAL

A pre-oiling test is an important phase of the preparation of the B-29 super-engines for their operating and final tests at Chrysler Corporation's Dodge-Chicago plant where these powerful power plants for the super-fortresses are turned out in huge quantities. An electric motor provides the motive power necessary to turn the engine crank-shaft during this vital check-up.

A dual-speed, 50-100 hp., 1200-1800 rpm., 3-phase, 440-volt, motor with shaft speeds of 150-300 rpm., is mounted on a stationary trestle just high enough to bring the motor shaft in line with the propeller shaft of the engine on test. The assembled engines are rolled in on their dollies and coupled to the motor. As the propeller shaft is turned by the motor, oil under pressure is forced into the engine parts.



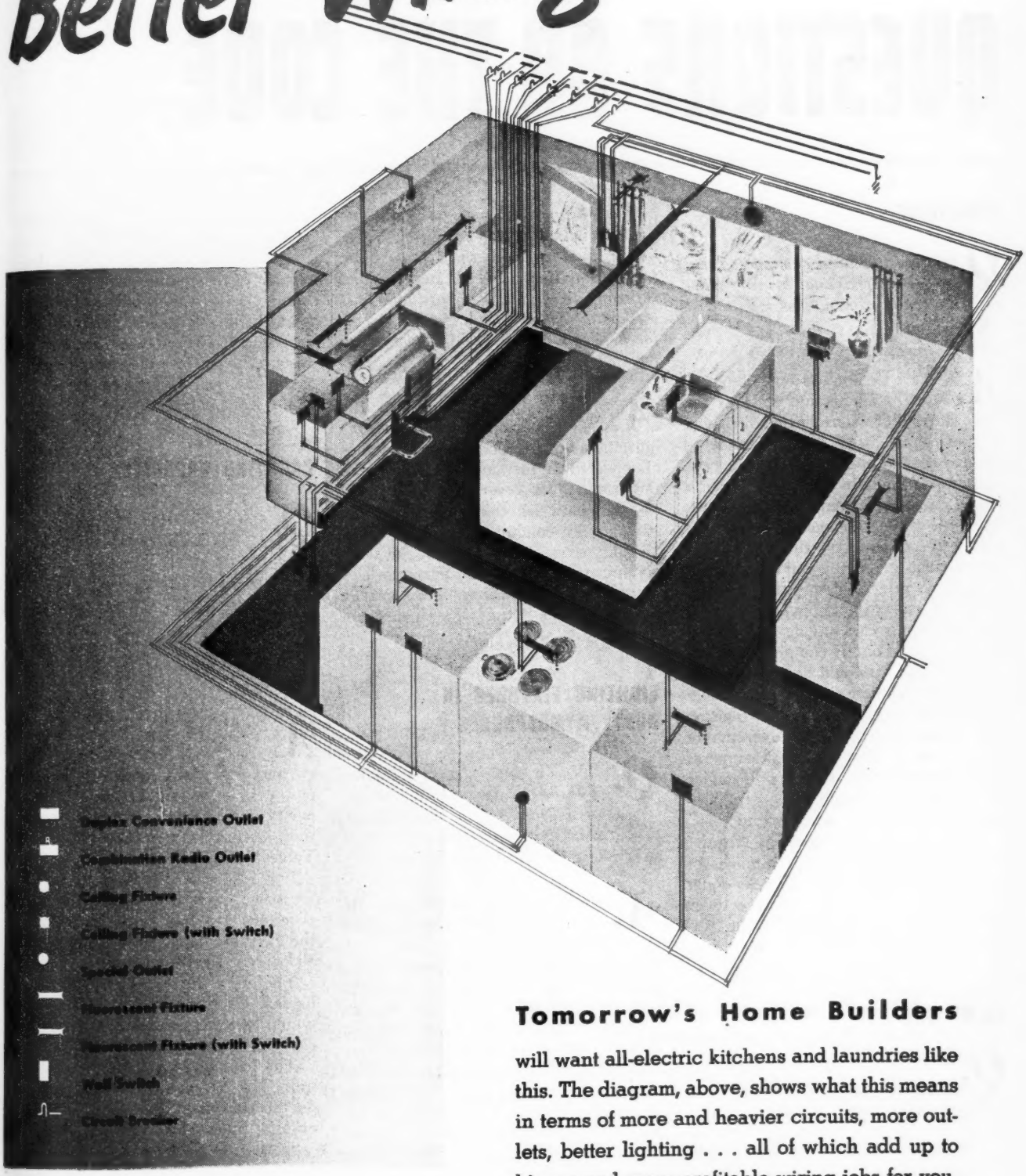
COMPACT DISTRIBUTION *panel fits into the cramped quarters of an LCT craft engine room. All switches are equipped with a thumb-screw device for locking them in the closed or open position. Ferrule type fuse holders have wire clips to prevent vibration from loosening contacts. Hand rail is added to panel for safety reasons.*

Complete lubrication of all sections of the engine is accomplished and leaks in gasket seals and oil lines are discovered and faulty parts replaced.

After this test engines go to the test cells for running tests under their own power. Following the running test, the units are completely disassembled and the parts carefully checked. If in perfect condition, the engine is again assembled and placed in the test cell for its final operational test.

PRELIMINARY CHECK *on oil lines and gasketed seals is being made on this B-29 engine at the Dodge-Chicago plant. As electric motor rotates propeller shaft, oil under pressure is forced into the engine's lubricating system. Engine then goes into test cell for running test.*

Better Wiring



Tomorrow's Home Builders

will want all-electric kitchens and laundries like this. The diagram, above, shows what this means in terms of more and heavier circuits, more outlets, better lighting . . . all of which add up to bigger and more profitable wiring jobs for you.

Use the two Westinghouse books shown on the opposite page to help sell and install such "full-profit" jobs. Contact your nearest Westinghouse distributor or district office, or write Westinghouse Electric & Manufacturing Company, P. O. Box 868, Pittsburgh 30, Penna.

Department

Answered by
F. N. M. SQUIRES and GLENN ROWELL
Chief Inspector, New York Board of Fire Underwriters, New York, N. Y.
Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.

QUESTIONS ON THE CODE

GROUNDING

Q. *"Does a driven ground rod that has approximately 24 ohms resistance to ground provide a safe ground?"—J.A.*

A. As a Code question this one is tough, as Section 2584 of the Code states that where buried or driven electrodes are used the resistance to ground shall not, if practicable, exceed 25 ohms and where the resistance of a single rod does exceed 25 ohms, two or more electrodes connected in parallel shall be used. Probably the best answer that can be given to your question is found by referring to I=E/R. The Code consists of minimum requirements and while a ground having 24 ohms resistance would barely comply with Code requirements, it would permit the flow of only 4.8 amperes of current at 115 volts. With such a condition, a fault on any circuit protected with overcurrent devices set at more than five amperes would not open the overcurrent device if a return through the grounded neutral were being depended upon.

Many inspection agencies require neutral grounds having resistances of not more than five ohms, and no doubt this is a very wise practice even though it is not required by the National Electrical Code.—G. R.

LIGHT CIRCUIT

Q. *"Does the circuit shown in the accompanying sketch meet Code requirements? Switches Nos. 1 and 2 control yard and porch lights as well as the garage light. The garage light is controlled also by switch No. 3, which is normally in the UP position. For garage lights ONLY switch No. 3 is thrown to the DOWN position. This method also provides a "hot" circuit for a receptacle yet requires only four wires."*—N.C.S.

A. The layout according to the sketch complies with the requirements of the Code as the switches all operate in the ungrounded side of the circuit. However, if it is intended to run between the house and the garage with conduit or armored cable, all four wires must be within the same conduit or armor. With open work or non-metallic sheathed cable (if garage is attached to house) this would not apply.—F.N.M.S.

LIGHTING FIXTURES IN DUSTY ATMOSPHERES

Q. *"May a lighting fixture labeled by the Underwriters Laboratories for a Class 1 Group D location be used in a grain elevator or flour mill where subject to dust?"*—M.C.

A. No, the Code forbids the use of such a fixture where subject to combustible or explosive dusts. A fixture for such a room should be approved for use in a Class 2 Group G location. While it is possible that an individual fixture might be so designed that it could be approved for use where subject to either combustible dusts or explosive petroleum vapors, it is unsafe to assume that a device approved for use when subject to explosive vapors is also safe when used in dusty atmospheres. These devices must be designed to dissipate heat; and a device capable of dissipating heat in dust free but explosive vapor laden atmosphere might be unable to adequately dissipate heat when covered with a coating of dust, resulting in either actual ignition of the dust coating or premature failure of the light bulb.—G.R.

CARRYING CAPACITY

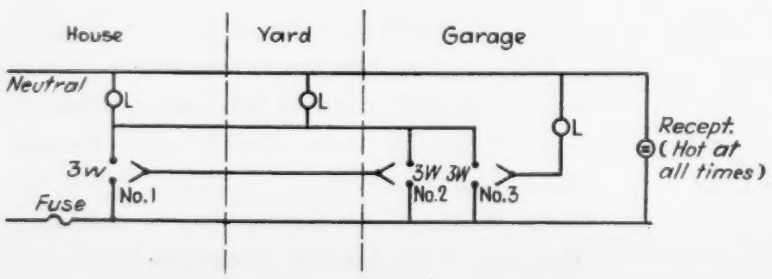
Q. *"I have been called on to install four No. 12 SN wires in ¾-in. conduit to supply two heaters each consuming 24.5 amp. Each heater is on a separate two wire circuit. Do these overload the wires? These heaters are on for about 6½ hours at noon and about four hours in the evening."—J.B.*

A. Yes, the wires are overloaded. Inasmuch as each of the wires is carrying current and there are four in the same conduit, the carrying capacity is subject to 80 percent correction, according to Note 5 following Table 1 of the Code.

For SN wire the carrying capacity for three wires in a conduit is 23 amperes but for four wires in a conduit the carrying capacity is 23 amp. times 80 percent or 18.4 amperes.

Therefore the wires would be overloaded. Even the load of 24.5 amperes would be excessive for a wire having a carrying capacity of 23 amperes.

The load of 24.5 amperes would require No. 10 wire with SN insulation, as the carrying capacity would be 28 amps. times 80 percent or 24.8 amperes.—F.N.M.S.

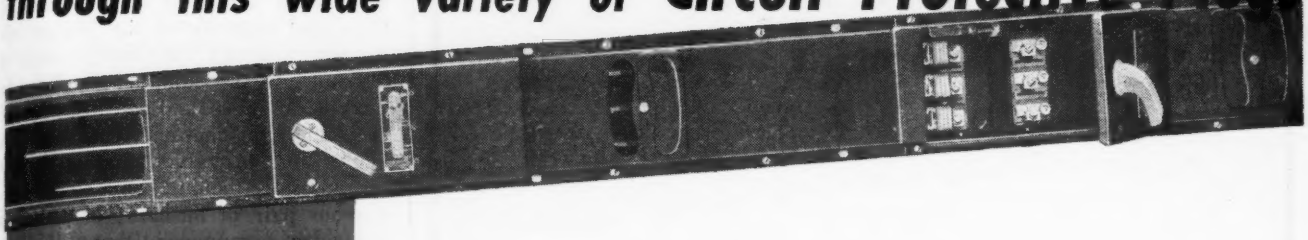


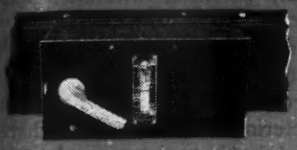
FUSES IN MULTIPLE

Q. *"For overcurrent protection on a power service of 800 amperes, I recently found it necessary to place fuses in multiple. Due to shortage of stocks, I was unable to use 400 ampere rated fuses of the same brand, and the*

With BULLDOG BUStribution DUCT

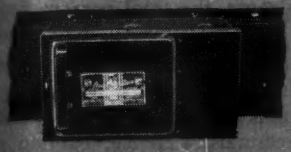
you can get increased capacity, flexibility, completeness, through this wide variety of Circuit Protective Plugs





VACU-BREAK SWITCH PLUG

Fusible and non-fusible, 30 to 600 amp., 2 or 3 pole, 575 volts or less, or 4 pole solid neutral 230 volts A.C. H.P. rated.



TYPE "PB" BUS PLUG

Cover operating types, in 30, 60 or 100 amp. Horsepower rated. Fusible and non-fusible, 575 volts or less.

CIRCUIT BREAKER PLUG

For use where an automatic protective device is required, with either rigid or flexible conduit — max. capacity, 600 amp., 600 volts.

CIRCUIT MASTER PLUG

Designed for single pole circuits for 120 volts and 2 pole for 208 volts, 15 to 50 amp.

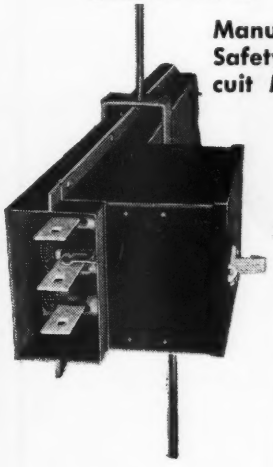
The wide variety of pre-fabricated circuit protective tap-off plugs available for use with BUStribution DUCT is just another example of the thoroughness of BullDog engineering.

Built for every circuit protective purpose, BullDog Standard Bus Plugs give you both increased capacity and complete flexibility for rearrangement of production machinery. Additional outlets can be installed quickly and inexpensively—change-overs can be made in minimum time, with minimum labor cost and no material loss.

All Bus Plugs fasten securely to the flanges of the duct section at the plug-in openings, may be mounted on either or both sides of the duct and require no auxiliary screw clamps or fittings. Engagement with the bus bars is made through spring reinforced contact fingers so designed that accidental contact with live parts is impossible.

For complete information on the various BullDog Bus Plugs illustrated in this advertisement, write for our illustrated bulletin 427-2.

Manufacturers of a complete line of Vacu-Break Safety Switches, Panelboards, Switchboards, Circuit Master Breakers and BUStribution SYSTEMS.



MOUNTED PLUG

This end view of a plug mounted on duct shows how the copper "contact" fingers of the plug clamp over the bus bars in the duct.

Speed Victory — Buy More War Bonds!

BULLDOG

ELECTRIC PRODUCTS CO.

BOX 177, R. PK. ANNEX
DETROIT 32, MICHIGAN

BullDog Electric Products of Canada, Ltd., Toronto, Ont.

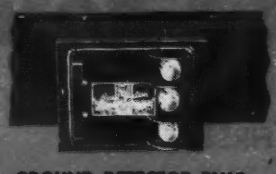
Field Engineering Offices in All Principal Cities

TEMPERATURE INDICATING PLUG

When temperature of bus bar exceeds 90° C. (212° F.) (30° C. ambient plus 70° C. rise), lamp automatically lights.

CAPACITOR PLUG

Convenient and flexible means for improving Power Factor. Available from 1 to 10 K.V.A., 230 or 460 volts, 60 cycle A.C.



GROUND DETECTOR PLUG

7½ watt externally mounted Mazda lamps provide visual indication for [illegible] grounds or system.

Dependable Protection

MONARCH FUSE COMPANY, LTD.

116 E. FIRST STREET JAMESTOWN, N. Y.

question has now been raised concerning Code compliance. Is this a Code violation?"—H. M.

A. The N. E. Code under Section 2411 states that fuses may be used in multiple when the capacity of the circuit protected is in excess of the rated capacity of the largest approved cartridge type fuse, which is 600 amperes providing as few fuses as possible are used and the fuses are of the same type, characteristics, and ratings; and providing the fuseholder terminals are mounted on a single continuous pair of busbars; or have an equivalent arrangement that will eliminate any potential difference between the terminals of the fuses.

It is entirely possible that the 400 ampere fuses manufactured by two different concerns might have similar characteristics. It would therefore seem advisable to determine by test the resistance offered and if they are similar their use would be in compliance with the N. E. Code, but if the resistance offered by the different fuses is not the same, the total current flowing would not be equally divided between them and they could not be used in multiple. This same unequal flow can be brought about by poor contact at the fuse terminals. Hence, caution must be exercised to make sure of proper connections.—G.R.

ARC WELDERS

Q. *"One of our war plants recently purchased several transformer type arc welders rated at 24 amperes 220 volts and we were asked to provide outlets for them. Each welder was provided with a general use disconnect switch rated at 30 amperes and now the inspector has refused to O.K. the installation as he claims we should have used larger switches. After looking through our copy of the 1940 Code, we cannot find any such ruling and will therefore appreciate any assistance you may be able to offer."*—H.P.

A. If the transformer type arc welders are of the power factor corrected type with correction to at least 75 percent, a general use switch having a rating of at least twice the full load current rating of the welder may be used for the disconnecting switch. If the welders are not of the power factor corrected type, the disconnecting switch must be of the motor circuit type having a horsepower rating similar to the full load current rating of the welder.

This ruling was adopted by Interim Amendment No. 58 approved on Sep-

tember 10, 1942 by the National Electrical Code Committee and therefore does not appear in the 1940 edition of this Code but is printed in the supplement which you apparently do not have.

This ruling was brought about by a great number of accidents which occurred when the electrode fused to the work and the workman attempted to open the disconnect switch. The resulting arc on some occasions actually vaporized a sufficient amount of the copper within the switch cabinets to cause them to explode, resulting in injury to the person attempting to open the switch. Subsequent investigation usually revealed that the switches used were of the general use type with ratings similar to or even less than the full load current rating of the welder.—G. R.

LIMIT TO NUMBER OF WIRES IN RACEWAY

Q. *"Section 3466 governs the number of conductors in a raceway and refers us to Tables 4 to 11 of Chapter 10 for the specific limitations. Table 4 limits the number of wires to 9 as that is the largest number mentioned. However, Table 11 states—"For groups or combinations of conductors not included in Tables 4 to 10 ...", a method of computing conduit sizes is presented.*

If I want to run say fourteen No. 14 wires in a single conduit and as this group of fourteen wires is not covered in Table 4, can I use the percentages given in Table 11 for computing the conduit size? The wires are for lighting or appliance branch circuits."—A.E.P.

A. No. The intent of Section 3466 is to limit the number of conductors in a single conduit to not more than 9, regardless of the size of the conduit.

The only exceptions to this rule are for motor control circuits, stage pocket and border circuit work, sign flashers, and elevator control circuits as mentioned in the footnote to Table 9.

For ordinary branch circuit work, the intent of the Code is to restrict the number of conductors to 9.—F.N.M.S.

WIRING LIGHTING FIXTURE

Q. *"May a 750 watt single lamp fixture be wired with a type CF fixture conductor?"*—S.K.

A. No, fixtures with mogul base lamp holders must be wired

WHEN MOTOR CONTROL IS

UNITROL

Reg. U.S. Pat. Office

Simple way to house motor control

YOU'RE READY FOR THE SHIFT

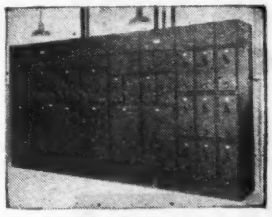
At times like these when plant executives must be ready on a moment's notice to shift plant facilities from one type of production to another, you're lucky if your Motor Control is UNITROL. This newest of all forward steps in Motor Control equipment pioneered by Cutler-Hammer Engineers, gathers up controls scattered throughout a plant, concentrates them into one compact centralized unit that makes room for *more* control, *more* machines, *more* operations. UNITROL houses all the control within the space of a few steps and lightens the labor of servicing and inspection. UNITROL requires no costly building, no costly wall or floor preparation, now or later. And above all, UNITROL makes possible the easiest, speediest and least costly rearrangement and reorganization of production equipment. Only machines, not the control, need be relocated. The individual control units can be changed at will, sections added, taken away or rearranged like the filing cabinet sections in your office.

Take advantage of today's opportunity to modernize your control equipment by replacing it with UNITROL and be ready for the shift, any shift now or in the future. Let a Cutler-Hammer engineer survey your requirements. CUTLER-HAMMER, Inc., 1306 St. Paul Ave., Milwaukee 1, Wis. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ont.

The control is mounted in a UNITROL Door Frame.

The door frame is mounted in a UNITROL Section.

Sections are grouped together and joined.



Presto! you have a complete, compact plant-serving Motor Control center, ready for any need to come.

CUTLER-HAMMER

UNITROL

C-H

Engineering excellence finds its greatest reward in the respect and confidence of those it serves

• **Aerovox is still the pioneer—with a simple and profitable solution of the wartime servicing problem. You can now service those wornout motor-starting capacitors and keep old refrigerators running with Aerovox universal replacements.**

Only 28 universal numbers—22 for 110-volt, 6 for 220-volt—take care of upwards of 90% of all motor-starting replacements. Handy Aerovox conversion chart indicates proper universal type for any previously available type. Minimum stock; maximum service.

Ask Your Jobber...

ARMY (E) NAVY

• **Ask for Aerovox motor-starting capacitor replacements. Ask to see the Aerovox conversion chart. Or write us direct.**

AEROVOX Capacitors

INDIVIDUALLY TESTED

AEROVOX CORP., NEW BEDFORD, MASS., U. S. A.
In Canada: AEROVOX CANADA LTD., HAMILTON, ONT.
Export: 13 E. 40 St. New York 16, N.Y. · Cable: "ARLAB"

with type AF fixture wire. Type CF wire can only be used for fixtures equipped with other than mogul base lamp holders and then only when the voltage between conductors is less than 300 volts and the maximum temperature does not exceed 194 degrees fahrenheit. See Section 4139 of the National Electrical Code.—G. R.

RANGE SWITCH

Q. *"Our Electrical Inspector refuses to O.K. my job because I have fastened a 60 ampere range switch to a concrete block wall with wood screws and wood plugs. This has been accepted by the previous inspector and has been the practice for years. Is there any special rule which prohibits this?"—L.D.*

A. Your new inspector is enforcing Section 1106 of the National Electrical Code by refusing to accept wooden plugs driven into holes bored in masonry. The Code requires that equipment be securely mounted and under the above mentioned Section you will find the following statement: "Wooden plugs driven into holes in masonry, concrete, plaster and similar materials shall not be depended on for security."—G. R.

HAZARDOUS LOCATIONS

Q. *"Would a wooden furniture factory be considered a hazardous location requiring the use of special electrical equipment?"—O.D.*

A. Each woodworking plant must be considered individually as the hazard common to one might not be present in another. It therefore is necessary for the local inspection authorities to determine in each such plant the areas which should be considered hazardous Class II locations. In many woodworking plants the dust hazard may be common only in the sawdust storage room; in others, dusty locations may be found adjacent to certain operations, such as sanding; while in plants using well dried lumber the dust hazard may be quite severe adjacent to many different types of machine operations depending largely on the efficiency of the refuse removal system. In many woodworking operations it is difficult to prevent sawdust and chips from forming a blanket covering the motor or motors, and where such conditions are found the motors should be of either the dust-tight or totally enclosed types.—G. R.

HOLLOW SPACES

Q. *"Will you be good enough to clarify the sub-paragraph printed in small type under Section 2331, page 45 of the N.B.F.U. pamphlet number 70?*

"Does the phrase, within the hollow spaces of frame buildings, include the attics of such buildings, or is it intended to indicate only the spaces within the studding and the inner and outer walls?"—J.A.J.

A. The term "hollow spaces of frame buildings" means the dead air space inside of the walls, ceilings or floors, such as the space between the laths of an interior wall, or the space between the weather boards and laths of an outside wall, or between the ceiling laths of a ceiling and the floor boards of the floor above. The intent is to keep the service wires, which are not protected against overcurrent, out of these combustible spaces. If the wires are protected by overcurrent devices at their outer end, they may then be run within these spaces. It is permissible to run the unprotected conductors straight through a frame wall from the outside to the inside of a room to reach the service overcurrent device.

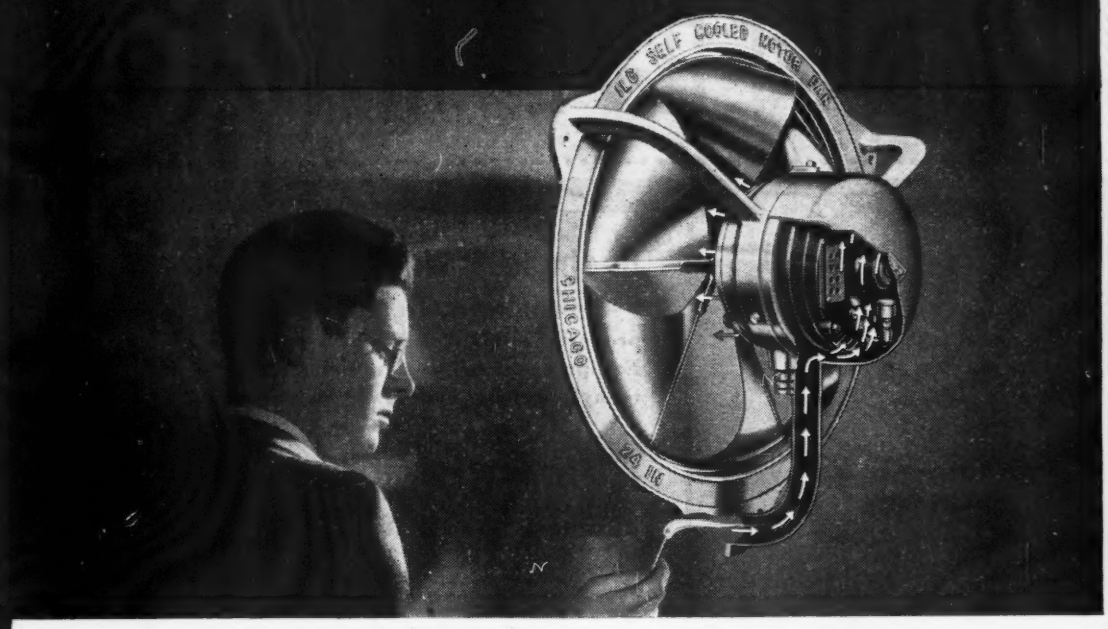
It is not recognized as meeting Code requirements to run service wires for any appreciable distance within an attic space before affording it protection against overcurrent. The service fuse should be as close to the point of entrance as possible.—F.N.M.S.

GROUNDING ELECTRIC RANGE FRAME

Q. *"Where in the Code is permission given to ground the frame of an electric range to the grounded circuit conductor?"—M.C.*

A. Many inspection authorities have, during the past, used Section 2556-c as granting them the right to give special permission for the grounding of the range frame to the grounded circuit conductor. Then on July 10, 1942 Interim Amendment No. 53 was adopted by the National Electrical Code Committee. This amendment reads as follows: "Frames of electric ranges which are to be grounded may be grounded by any of the means provided for in Sections 2556 and 2558. If not so grounded and if not connected to or in contact with other grounded equipment or structures, they may be grounded by connection to the grounded circuit conductor."—G. R.

WHY ARE ILG MOTORS "SELF-COOLED"?



To operate at peak efficiency in the polluted air stream of an exhaust fan!

Open-type motors for ventilating duty have windings exposed to dust, grease and foreign matter in air stream—soon "gum-up," lose efficiency, require more power, overheat. *Fully enclosed type* motors must be larger to avoid overheating, consume more current, block out greater portion of fan area—deposits form a blanket of insulation causing motor to "run hot."

Recognizing these difficulties, ILG designed and built its own motor with patented self-cooling feature to operate at peak efficiency with an exhaust fan. Since it is *an open-type motor*, you reap the benefits of smaller size, lower operating costs (saves 5 to 10%!). *Removable metal hood* over motor prevents foreign matter from depositing on windings to interrupt service. *Vent pipe* brings in fresh, cool, *outside* air to circulate through motor. Motor stays clean, cools itself, operates efficiently for years with a minimum of attention.

For more details on this exclusive ILG feature and free copy of 88-page ILG-BOOK, phone nearby Branch Office (consult classified directory) or write us today.

ILG

VITALIZED VENTILATION

AND AIR CONDITIONING

FREE!

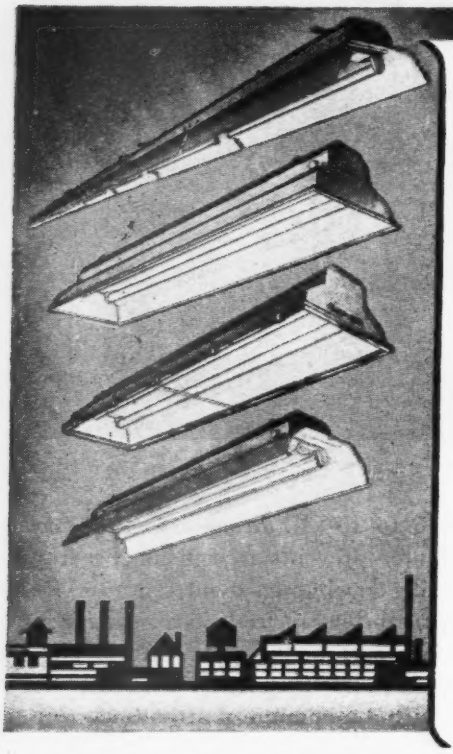
88-page book on solutions to ventilating problems.

WANTED: GRADUATE ENGINEERS!

for ILG Branch Offices, also Research and Engineering Departments. Exceptional opportunities now and post-war for graduates of accredited technical schools. Send details on education, experience, health, age, marital status, etc.

ILG ELECTRIC VENTILATING CO., 2879 N. Crawford Avenue, Chicago 41, Ill., Offices in 38 Principal Cities

How "RIGHT" Lighting Helps CONSERVE MANPOWER



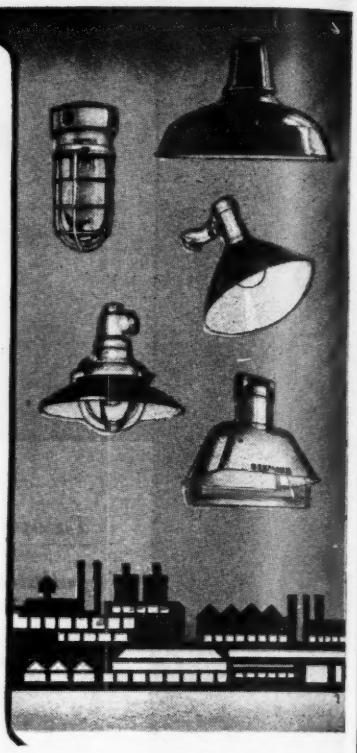
In these 3 Ways...

"RIGHT" LIGHTING as provided by properly applied Benjamin Lighting Equipment is helping Industry to meet today's pressing manpower problems...

1. Protects plant personnel against accidents.

2. Conserves energy and reduces fatigue.

3. Helps older employees to "Stay-on-the-Job"



PROMOTES SAFETY. The influx of new, inexperienced men and women, many of whom are unaccustomed to industrial occupations and the increase in the average age of the working force accentuates need for maximum accident protection. Further, demands for sustained, high speed production and day and night shifts have increased the *problem of fatigue* as a cause of accidents.

"RIGHT" Lighting is helping in the solution of this aggravated Safety problem in two ways. First, enough light enables the individual to *see hazards easier and more quickly*.° It takes time to see*. The more light, however, the less the time required to see and to act*. The more light, therefore, the fewer accidents!°

Further, "Right" Lighting makes *seeing easier and less tiring*. To secure such lighting requires attention to many details such as the elimination of unshielded or improperly shielded light sources, proper painting of walls, ceilings, machines and working surfaces, and provisions for uniform distribution of the light over the work areas. These and other factors help to increase visibility and thus minimize eyestrain and fatigue*, the enemies of alertness against accidents.

**from I.E.S. report "Value of Good Lighting in War Production"*
°from booklet "Plant Efficiency" published by War Production Board

COMBATS FATIGUE. Not only is fatigue the cause of accidents, but also, an important factor in rate and quality of production, absenteeism, health and morale. "Right" Lighting helps solve the fatigue problem by reducing the drain on the worker's reserve energy. For seeing requires energy!* The better the lighting, the less the drain!*

KEEPS OLDER MEN ON JOB! "Right" Lighting benefits the older employee and those with deficient vision of all ages even more than those with normal vision. More light helps compensate for visual deficiencies and the loss of visual acuity due to age. Given this additional light, the manpower represented by this large group can be efficiently utilized for war production.°

• • •

Write for Free Booklet entitled "Productive Lighting" containing much valuable information on how Benjamin Lighting Equipment enables you to obtain "Right" Lighting for your plant. With it will be sent complete information on how to obtain, without cost or obligation, the assistance of a Benjamin Trained Lighting Specialist in analyzing the performance of your lighting and in making recommendations.

BENJAMIN ELECTRIC MFG. CO., Dept. H, Des Plaines, Illinois

BENJAMIN

Your Warranty of Uniform Quality

BENJAMIN TRADE MARK

Lighting Equipment

Distributed Exclusively Through Electrical Wholesalers

814

INDUSTRIAL ELECTRIFICATION

ENGINEERING • INSTALLATION • MAINTENANCE

Selection and Application of Synchronous Motor Control—IV

Synchronous motor starting characteristics with the five principal types of control are discussed in this last article of a series on synchronous drive as applied to industrial operations.

By A. P. Burris,
New York District Manager
Electric Machinery Manufacturing Co.

SYNCHRONOUS motor control consists of two fundamental parts; first, the connection of the stator or armature windings of the motor to the source of power, and second, the application of the excitation current to the field winding of the motor.

Of all the modern day types of motors, the synchronous machine was the last to come into widespread use. The early synchronous motor was in reality, an inverted alternator, with a minimum of starting torque. Motor designers, however, found the way to overcome these torque problems, but lacked automatic or, more properly, magnetic type of control to simplify the starting operation.

Prior to 1921, a synchronous motor control generally consisted of a manually operated, reduced voltage switching equipment to connect the motor to the source of power. This would consist of a compensator for voltages of 550 or less, and two oil circuit breakers plus an auto transformer for the higher voltages. The field application equipment consisted of a two pole knife switch. An alternating current ammeter, to measure the line current usually completed the control.

The operator would connect the motor to the line, on reduced voltage, through the compensator. "By ear", he would estimate when the motor had accelerated to the highest speed it would probably reach on reduced voltage. Switching manually over to full voltage would bring the motor up close to synchronous speed, at which point he would close the knife switch, applying the excitation to the motor field. This indeed required both skill and close application to successfully get the motor synchronized and on the line. Closing the field switch too soon would probably prevent it from having sufficient torque to pull into step. As a result, it would come to a quick stop. A disturbance to the power system would result, and a possible injury to the motor or driven machine. Too slow an application of the field current, on the other hand, would result in a prolonged disturbance on the electric system because of the motor running at a lagging p.f. and high current.

This type of control required that the operator immediately open the field switch, to prevent the motor stalling, if a voltage dip caused it to drop out of step. Failure on the part of the operator to open the field switch when shutting down the motor would result in an excessive heating of the field and probable damage to the motor. Further, remote control of a synchronous motor was not possible as the operator had to be at the control panel both when starting and when stopping the motor.

The first successful automatic control of any form for synchronous motors was put into operation in 1921. It controlled a low voltage synchronous motor which drove an air compressor. A magnetic air break contactor was the primary switch. The automatic application of the excitation, through the field contactor, was controlled by a frequency relay, invented by C. Truman Hibbard, chief enginer of the Electric Machinery Manufacturing Company. This relay was destined to play a large part in the development of a widespread use of synchronous motors as it was the prime factor tending to eliminate the problem of manual synchronous motor starting.

The functions of a complete synchronous motor control are to:

1. Connect the motor stator winding to the line.
2. Apply excitation to the motor field, at the proper time and with a minimum disturbance.
3. Protect the motor against overload, undervoltage, short circuit, etc.
4. Indicate its performance through meters.
5. Provide adjustment of motor operating power factor.

Of the five functions listed above, the different fundamental types of synchronous motor control vary only in the first instance. That is, the last four functions are the same regardless of what type of switching equipment is used to connect the motor stator winding to the line.

There are several possibilities to be considered when determining the best method of performing the first of the foregoing functions. Five principal types of control are used with synchronous motors. These are:

1. Full voltage
2. Part winding
3. Reduced voltage (auto transformer)
4. Reactor
5. Resistor

Full Voltage Control

Full voltage, or across the line starting should always be used unless the driven machine requires two or more increments of starting torque, or the power system limitations require a starting current below that of the full voltage inrush. As is the case in the application of machinery of all kinds, simplicity is very desirable, and especially so when performance does not suffer. Full voltage control best qualifies for this requirement.

Fig. 1 illustrates the primary three phase connections to the motor in a simplified diagram of full voltage starting. The entire stator winding of the motor is energized with full line voltage through a magnetically operated breaker or contactor.

The majority of synchronous motors installed can be and are started by full voltage, full magnetic control. Because it is the simplest, it is the lowest in

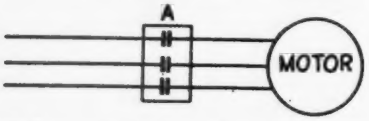


FIG. 1—Elementary diagram of connections for full-voltage starting, using one line switch, A, which connects the motor directly across the line.

first cost and requires the least maintenance. It is generally preferred wherever the previously mentioned requirements of increments of torque, or reduced current inrush are not necessary.

Fig. 2 is a typical dead front, full voltage, full magnetic synchronous motor control. It is for a 100 hp. 440 volt 3 phase 60 cycle, 1.00 power factor synchronous motor. Its primary switch is a magnetically operated air-break contactor.

Part Winding Control

Part winding starting requires that the stator or armature of the synchronous motor be wound in two or more parallel circuits. Full line voltage is applied to the first portion of the wind-

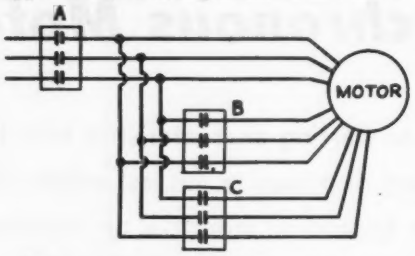


FIG. 3—Connection diagram for three-step part-winding starting. Switch A is closed first, connecting one circuit of the synchronous motor stator winding to the line at full-voltage. After a suitable interval, paralleling switch B is closed, connecting the second circuit of the motor to the line. Then the second paralleling switch C is closed, connecting the third circuit and thus completing the connection of the entire stator winding to the line.

ing by the closing of a magnetic contactor or breaker. The remaining part or parts of the stator winding are then energized by successively closing the remaining primary switches. Fig. 3 shows the simplified diagram of the primary connections of a three-step part-winding starter.

This type of control is used on the 500 hp. flour-mill lineshaft motor shown in Fig. 4. The three-step starting was used to give the operator a selection of three different torque steps. This allowed starting under any condition of mill load, and yet permitted a slow, gradual, controlled acceleration of the mill machinery. The primary switches for the three circuits are magnetically operated oil circuit breakers which are actuated by the pilot drum controller shown on the lower part of the control panel. The actual torque developed, together with the resulting current drawn from the line, are shown in the curves in Fig. 5. By use of the pilot drum controller, the operator can control the acceleration of the mill load. In the starting sequence shown in Fig. 5, the first part winding step results in 80 percent torque being applied. In this instance this is not sufficient to break the load away from rest, so the operator moves the controller handle to the second position. The 115 percent torque is sufficient to start the mill, as the curves indicate. At about 60 percent speed, the final primary switch is closed, energizing the remaining one third of the motor winding.

Part-winding offers many possible variations by grouping the motor circuits to give different torque steps. Figure 5A and the oscillogram in Fig. 6 illustrate the characteristics of a motor winding consisting of three equal parts. Figure 5B shows four step part-winding starting with a two circuit motor, which adds phase groups successively instead of complete parallel circuit.

If on occasions the starting load of the motor illustrated in Fig. 5A should be heavier than normal, it might be necessary to go to the third step to secure sufficient breakaway torque. This would tend to cause a much more rapid acceleration of the mill load than might be desired. In this case, the operator would have to merely move

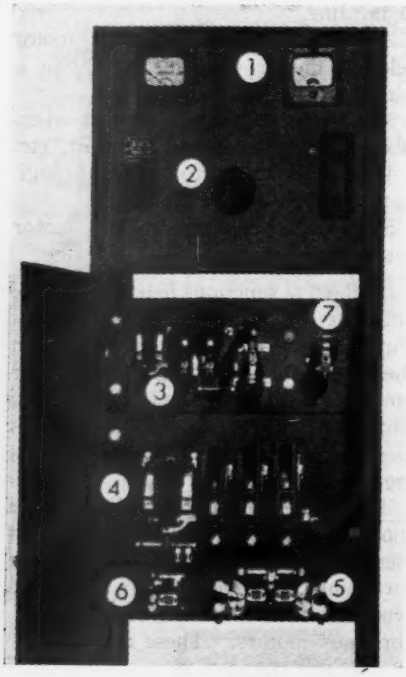


FIG. 2—Air-break, dead-front, full voltage control. (1) A-C line ammeter and D-C excitation ammeter. (2) Rheostat handle. (3) Field contactor. (4) Line contactor. (5) Overload relays. (6) Out-of-step-protective relay (7) Polarized field-frequency relay.

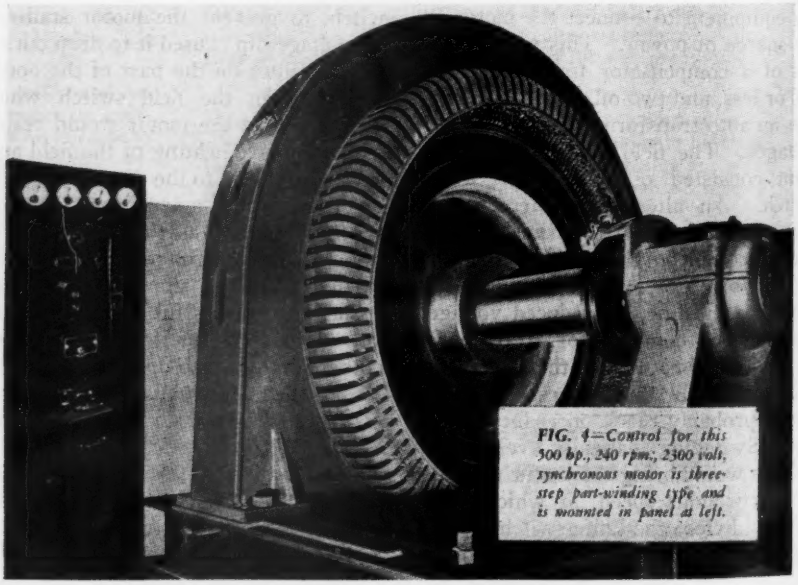


FIG. 4—Control for this 500 hp., 240 rpm., 2300 volt, synchronous motor is three-step part-winding type and is mounted in panel at left.

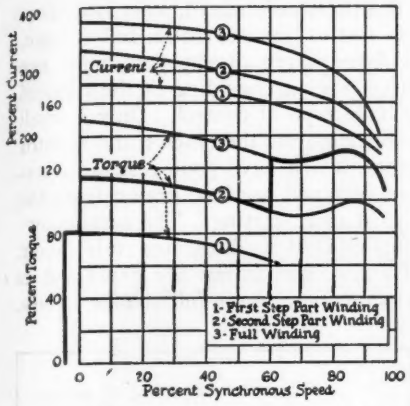


FIG. 5A—Starting characteristics of a 500 hp., 240 rpm., 0.8 power factor normal-starting current "Tork-Rite" synchronous motor driving a flour mill lineshaft. Heavy line shows use of the 3 part-winding steps during starting.

the controller handle back to the second or first position, reducing the torque applied, and with it, the acceleration of the mill. The oscillogram shown in Fig. 6 illustrates the motor voltage, motor current, and induced field current of a normal start on three-step part winding. The increased motor current in the last two steps is added as an increment to that already being taken. This is referred to as closed-transition starting. This type of part winding synchronous motor application has been installed with as many as seven steps. It allows a very accurate control of the load acceleration, and keeps the increments of inrush current to a minimum, thereby making it easier for the power supply to handle the load.

Reduced Voltage Auto-transformer Control

The reduced voltage auto-transformer control reduces the voltage applied to the motor and with it the torque and current inrush. Fig. 7 is a simplified connection diagram of the primary connections generally used. Contacts B and C, both of which are usually on the same switch, are closed first to connect the motor to the line through the auto-transformer at the reduced voltage. When a proper motor speed has been reached, B and C open together and A is closed, connecting the motor directly to the line.

Auto-transformers have two or three taps, allowing for a choice of voltage, at 80 percent, 65 percent, and sometimes 50 percent. The starting torque of the motor and the starting current

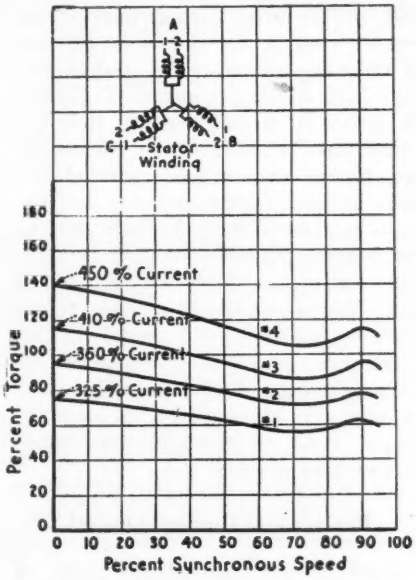


FIG. 5B—Starting torque and starting current values for four-step part-winding starting of a 450 hp., 225 rpm., 2200 volt synchronous motor. The motor is wound with two circuits: A1, B1, C1, being the three phase-groups on one circuit, and A2, B2, C2, the three phase-groups of the second circuit. Curves 2, 3, and 4 illustrate that the torque steps with part-winding starting are not limited to the number of parallel circuits, but can be substantially greater by connecting phase-groups to the line successively.

inrush vary as the square of the applied voltage. Thus a motor which exerts 160 percent starting torque and draws 575 percent starting kva. on full voltage, would when connected through the 80 percent auto-transformer tap, exert 64 percent (80 percent squared)

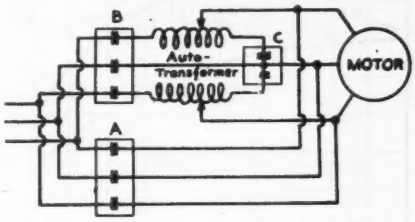


FIG. 7—Diagrammatic drawing of connections for auto-transformer type starting. Contacts B and C are closed first to connect the motor to the line through the auto-transformer at reduced voltage. When the motor has accelerated to a suitable speed, B and C are simultaneously opened, and A is closed, connecting the motor directly to the line.

of these values. That would result in about 102 percent starting torque with approximately 368 percent starting kva.

Fig. 8 shows representative starting kva. conditions of a synchronous motor when the control is of the standard reduced voltage type. The oscillogram also shows the motor current for this same starting period. It will be seen that in addition to the initial inrush, there is a disturbance when the transfer is made from reduced to full voltage. The circuit is opened during the transfer, this resulting in a magnetizing current surge as shown at B on the curve and also on the oscillogram. This is objectionable as the disturbance to the power supply may be worse at transfer than the initial inrush. The

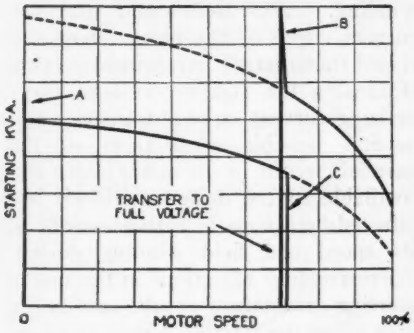


FIG. 8—Oscillogram and curve of motor current with auto-transformer starting. A and B show the high current surges at starting and at transfer to full voltage. C shows the entire break in the motor current at transfer. This break and the current surges are causes of voltage disturbances.

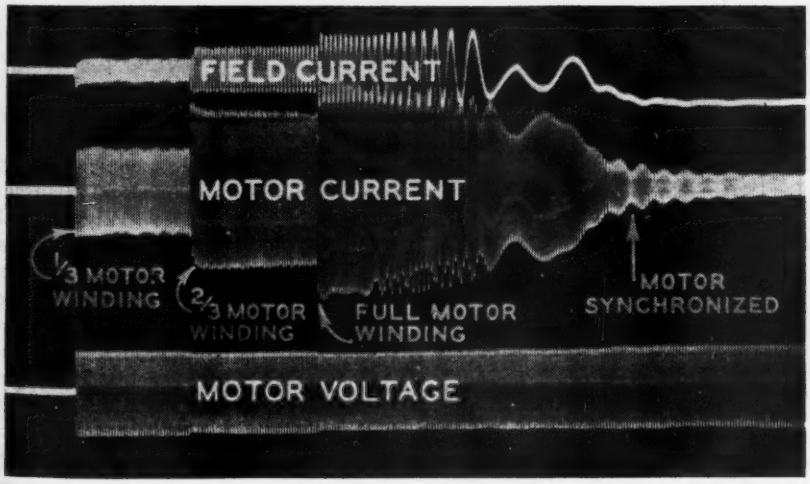


FIG. 6—Oscillogram showing motor voltage and current and field current during the starting interval (up to synchronism) of a three-step part-winding control.

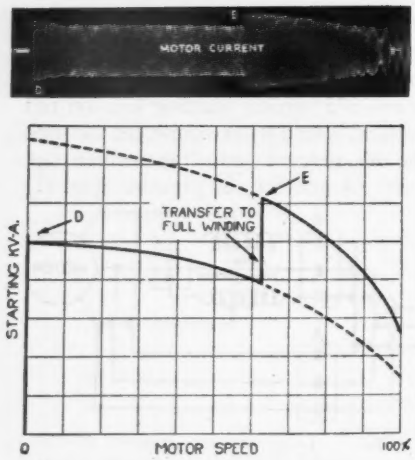


FIG. 9—Oscillogram and curve of two-step part-winding starting. D and E show the points corresponding to A and B at Fig. 8. Note the absence of high current surge at starting and at "transfer". The current simply rises to full-winding value without high momentary inrush and disturbance is minimum.

Korndorfer type of reduced voltage control allows transition through the addition of a third primary switch. With this type of control, B and C, in Fig. 7, are provided as separate switches. In starting, B and C are closed simultaneously, connecting the motor to the line through the auto-transformer. To transfer to full voltage, C is first opened, then A is closed, and B opened. The opening of C leaves the auto-transformer connected as a reactive coil between the motor and the line until A has been closed to apply full voltage. In this way, the Korndorfer reduced voltage auto-transformer control eliminates the open circuit condition during transfer from reduced to full voltage, and with it, the objectionable surge at transfer. Added cost and complication have prevented the use of the Korndorfer connection from becoming popular.

Fig. 9 illustrates starting kva. conditions of a motor, comparable to that in Fig. 8, but started on two step part winding. The oscillogram and the current curve of the motor show the closed transition of part winding. This eliminates the reduced voltage magnetizing current surge at transfer. The several possible connections of the parallel circuits in the motor armature, available to the design engineer, are affected by the motor rating as well as its speed and field winding design. Corresponding variations in the motor starting reactance result, which in turn affect the starting torque and kva.

For a two-step part winding motor start, the armature winding may be designed and connected as alternate pairs of poles under which condition both the starting kva. and torque which result are about 56 percent of the values obtained from the same motor on full voltage starting. Where design considerations require that the motor armature be connected as alternate poles, the starting kva. and torque are approximately 73 percent and 55 percent respectively, of the full voltage values. Thus the starting torque and kva. of two step part winding, using one of the two circuits on the first step, may be considered approximately equivalent to starting on the 75 percent or 85 percent tap of an auto-transformer, depending on which connection is used.

In first cost, the synchronous motor and the reduced voltage auto-transformer control are the same as that of the same rating motor with a two step part winding control. It should be borne in mind however that the motor must be designed for part winding, having two or more parallel circuits in the armature winding and the leads to these circuits brought outside the motor for connection to the switching equipment. Part winding eliminates the necessity of an auto transformer, has a simple switching arrangement, and avoids opening the circuit during transfer—offering these as inherent advantages over conventional reduced voltage auto-transformer type control.

Reactor and Resistor Control

Both reactor and resistor type of starting generally use a primary switch arrangement as shown in Fig. 10 which illustrates a four step resistor type control. Switch A is closed first, connecting the motor to the line through the entire resistor. B, C, and D are then closed, with a time interval between each closing, with each in turn short circuiting part of the resistor.

This type of control is sometimes used where increment starting is necessary to provide several progressive steps of starting current.

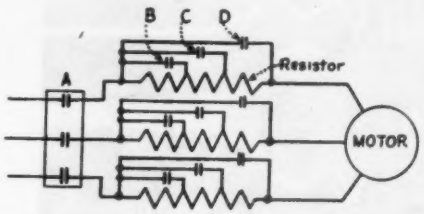


FIG. 10—Diagrammatic connections for four-step resistor starting. Switch A is closed first, connecting the motor to the line through the entire resistor. After suitable time intervals, switches B, C and D close successively short-circuiting out portions of the resistor until the entire resistor is out connecting the motor directly in the line. Connections for four-step reactor starting would be similar to those shown above, substituting reactors for the resisors.

As previously stated, most synchronous motors are started on full voltage. A large share of the remainder use either the part winding or the reduced voltage type of control. Only a small percentage use the reactor and resistor types, which have poor results in torque obtained per kva. drawn from the line during starting. The accompanying tabulation illustrates this point. The kva. and torque are expressed as a percentage of the full voltage values.

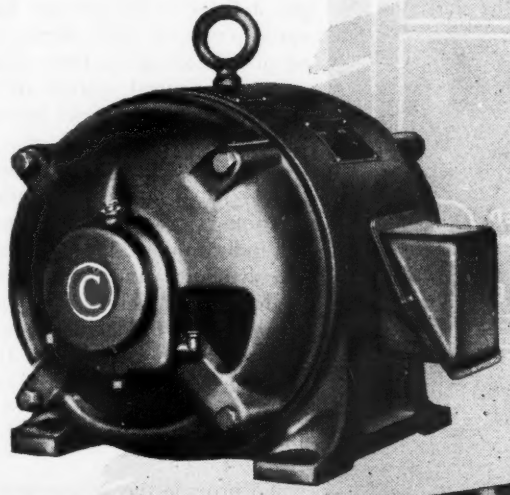
Method of Starting	% KVA. Drawn From Line	% Motor Starting Torque
1. Full Voltage ...	100	100
2. Part Winding (Two Circuit or Two Step)— varies	56 to 73	56 to 55
3. Auto Transformer:		
80% Tap	64	64
65% Tap	42	42
50% Tap	25	25
4. Reactor:		
80% voltage on motor	80	64
65% voltage on motor	65	42
50% voltage on motor	50	25
5. Resistor:		
80% voltage on motor	80	64
65% voltage on motor	65	42
50% voltage on motor	50	25

Application and Removal of Field Excitation

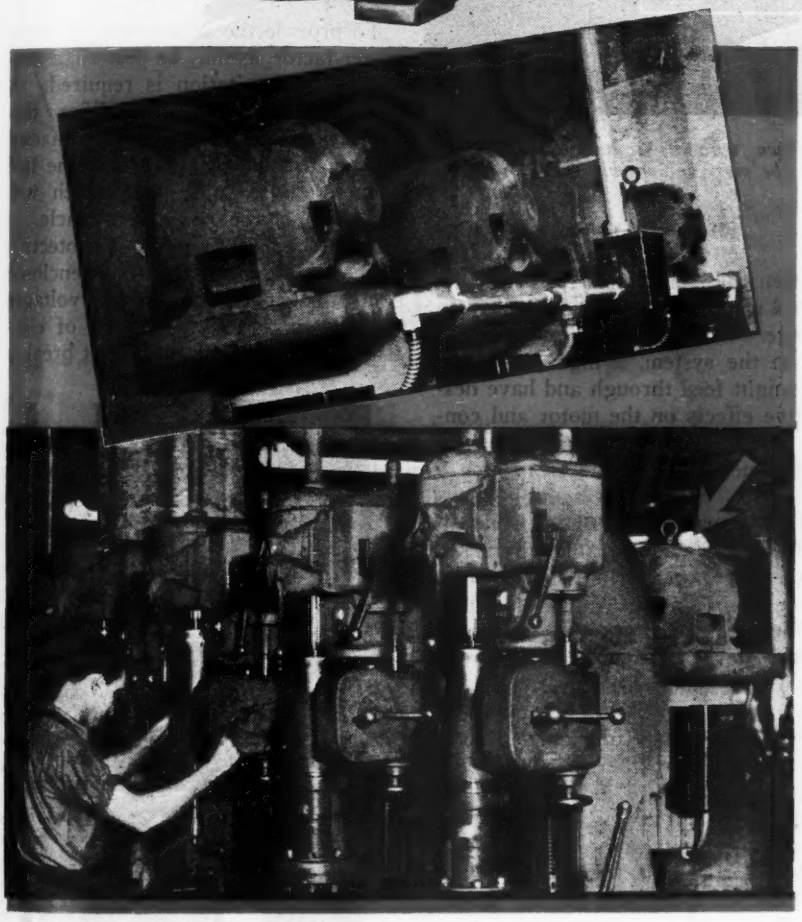
To apply the excitation to the field of the motor, the old two pole knife switch with its contact for inserting or removing the discharge resistor has given way to the magnetic field contactor. The relay which controls the operation of this contactor should apply the field at the proper pull-in speed and also at the most favorable relationship of rotor and stator poles to give the most powerful synchronizing torque with a minimum current.

The polarized field-frequency relay together with its connection diagram are shown in Fig. 11. With coil B connected as shown, shunted across the reactor in the motor field circuit, the relay armature A is pulled up the moment the motor starts. The induced field current declines in frequency as the motor accelerates, and an increasingly larger portion of it is diverted from the relay by the reactor. At about 95 percent speed, depending on the relay setting, the reactor shunts enough current from the relay to permit its armature to open. Since the

MODERN CENTURY PROTECTED INDUSTRIAL MOTORS



Are an important part of production tooling to meet industry's *peacetime* demands for lower costs



The upper half of the Century Form J general purpose, open, continuous duty motor is closed to minimize the possibility of dripping liquids or falling solids entering the vital parts of the motor.

This added protection feature is made possible because of the scientifically designed Century mechanical ventilation system. All motors generate heat, so if the insulation is to have long life, the heat must be rapidly carried away from the windings. Two fans located behind each bearing bracket draw cooling air "IN" through the openings of both bearing brackets. This cooling air is deflected first around the bearings to keep them cool and then across the windings and to air passages between the outer surfaces of the magnetic core and the frame — the heated air being finally discharged "OUT" through the lower sides and bottom of the frame.

These modern, protected, industrial, general purpose motors meet the requirements of more than 80% of all polyphase motor applications. This Form J construction is at present available in 2 to 25 horsepower four-pole frame sizes.

Your Century Motor Specialist has full information and his wide experience may well prove valuable to you. Call him today.

Century C MOTORS

409

CENTURY ELECTRIC COMPANY, 1806 Pine Street, St. Louis 3, Missouri

Offices and Stock Points in Principal Cities

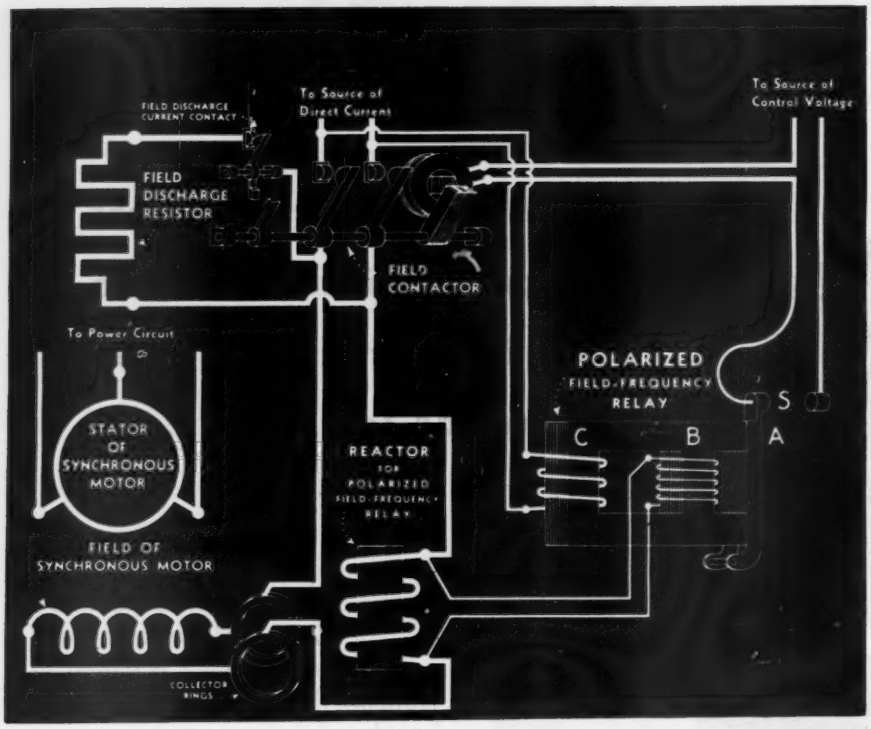


FIG. 11—Polarized field-frequency relay is shown with its connection diagram. Operation of circuit is to supply field under the most unfavorable conditions.

relay is polarized by coil C, connected to the source of excitation, the relay armature opens only when the magnetic fluxes of the two coils are of a certain strength and relationship. The design of the relay is such that contact S is made and the field applied at the correct speed and at the most favorable point for synchronizing.

Should the synchronous motor pull out of step from momentary voltage dip or overload, a surge of alternating current is immediately induced in the field circuit. A portion of this current flows through the induced-field-current coil of the relay and immediately opens the relay contact, removing excitation from the motor. Then if the motor has adequate pull-in torque (or automatic unloading is provided) the relay is instantly alert and ready to resynchronize the motor when normal line voltage is restored or the overload passed. Even if resynchronizing is not possible, the removal of field excitation whenever the motor is out of step greatly reduces the power-line disturbance and strain on the motor and driven apparatus.

Several other types of synchronizing relays have been used by various control manufacturers. The adjustable timing relay allows the operator to set it at a preset time interval that he estimates would be required to bring the motor up to speed. Other relays are actuated by the variations in motor current, power factor, or stator impedance to make them speed responsive.

Motor Protection

When the motor is in operation, the control must effectively protect it from damage. In the event of a short circuit in the system, a high fault current might feed through and have destructive effects on the motor and control. Some device in the circuit must be designed to open and clear such a condition. Sometimes a high interrupting capacity circuit breaker is used ahead of a group of motors. It would open and remove the entire group from the line in case a short circuit developed. In other instances, each motor has its own starting circuit breaker of sufficient interrupting capacity to clear the short circuit. Fig. 12 is a full voltage full magnetic control using still another means of short circuit protection. The fuses at the top of the enclosure are of the high interrupting capacity type. They open under short circuit, thereby permitting the use of a normal size oil circuit breaker.

Overload relays, generally of the thermal type, prevent motor damage from overheating which would result from carrying an excessive load. This type of protection is generally arranged in two parts, the first of which protects against damage from overload while the motor is in synchronism. The second is the out-of-step or squirrel cage protective relay which guards against damage from too long an operation out of synchronism (as a squirrel cage motor). Undervoltage protection is provided by opening the primary switch or contactor.

The specific conditions of a given installation govern the added protection that may be desirable. Such possibilities as d-c voltage failure, reverse phase or open phase protection or protection in all three phases of a grounded neutral system are available at extra cost and should be considered.

The meters included in a standard control are a line (a-c) ammeter and a field (d-c) ammeter. These are the minimum for intelligent operation as an indication of the current in both the armature and field is necessary. Many other meters are optional at extra cost. Such instruments as a watthour meter to record the energy consumed, an indicating wattmeter to show variations in load, or a power factor meter will often be well worth the cost.

To provide the adjustment of motor power factor, as may be desired, a control of the excitation is required. A power factor meter simplifies this operation, however the power factor can be adjusted by using only the line ammeter as a guide, and which was explained in the December article.

To assure a maximum of protection to the operator, dead front or enclosed control is generally used on all voltages of 2200 or above. A means of electrically isolating the oil circuit breaker

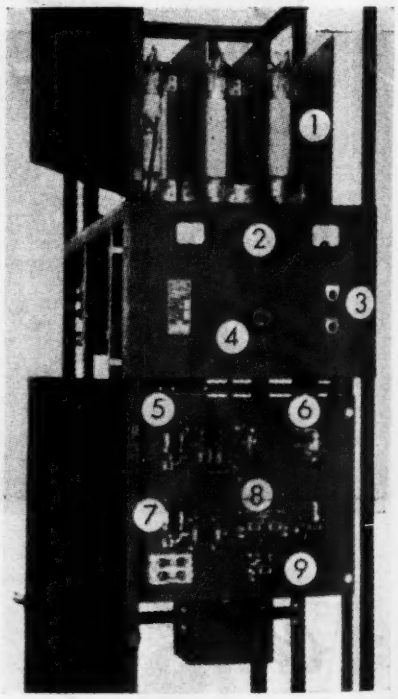
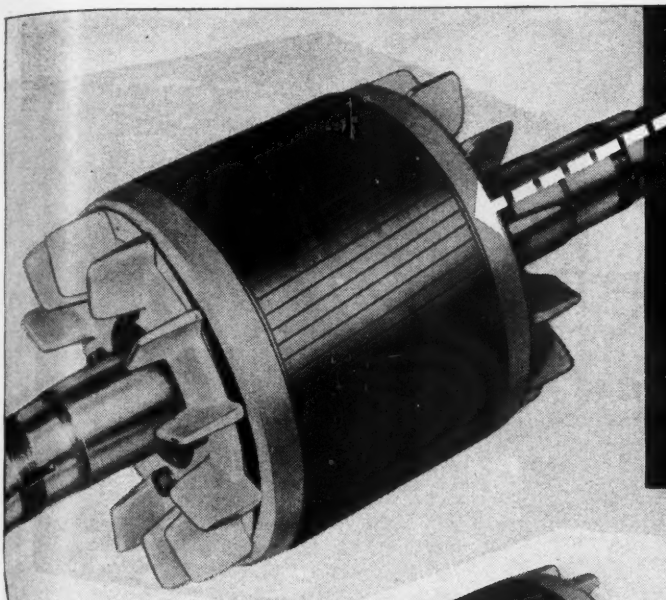
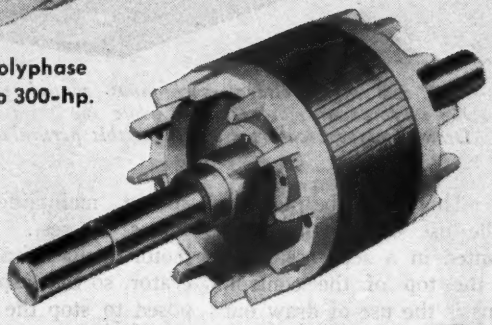


FIG. 12—Hi-fuse, full-voltage, magnetic control. (1) high interrupting capacity fuses. (2) meters. (3) push buttons. (4) rheostat. (5) field contactor. (6) polarized field-frequency relay. (7) control relay. (8) thermal overload relay. (9) out-of-step protective relay.

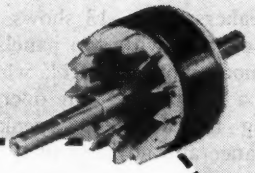
Cast Aluminum Rotor Construction GIVES LONG LIFE TO Wagner MOTORS



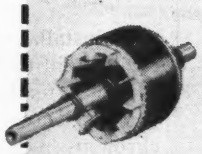
Rotor for polyphase motors 40 to 300-hp.



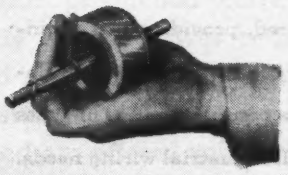
Rotor for polyphase motors 5 to 30-hp.



Rotor for polyphase motors 1/6 to 3-hp.



Rotor for split-phase motors 1/20 to 1/3-hp. and capacitor motors 1/8 to 3/4-hp.



Rotor for shaded-pole fan motors 1/125 to 1/30-hp.

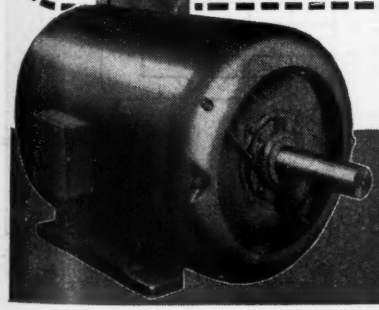
Hundreds of Thousands of Wagner Motors with Cast Aluminum Rotors have been built during the past 25 years and are giving perfect satisfaction.

★

- Wagner squirrel-cage rotors are cast under heavy pressure. The aluminum completely fills the rotor slots and tightly clamps the punchings.
- The rotor bars and endrings make complete and intimate contact with the core-iron, facilitating heat-transfer and absolutely eliminating squirrel-cage vibration.
- The squirrel-cages in all Wagner general-purpose motors are practically pure aluminum of high conductivity and ductility. They successfully withstand the most severe service because they are not affected by repeated heating and cooling and they cannot vibrate.
- A special patented construction is used in the medium and larger sizes to reduce the load losses and increase the motor efficiency.

The mechanical and electrical characteristics, inherent in cast aluminum rotors, have contributed in a large measure to the reputation for quality and dependability established by Wagner motors for the past 50 years.

***Write* for complete literature**



These Branch Offices are Ready to Serve You—

ATLANTA • BOSTON • CHICAGO • CINCINNATI • CLEVELAND • DALLAS DENVER • DETROIT • HOUSTON • INDIANAPOLIS • KANSAS CITY • LOS ANGELES • MEMPHIS • MILWAUKEE • MINNEAPOLIS • NEW YORK • OMAHA PHILADELPHIA • PITTSBURGH • PORTLAND • SALT LAKE CITY • ST. LOUIS SAN FRANCISCO • SEATTLE • SYRACUSE • TULSA • WASHINGTON, D. C.

Each of these offices is manned by trained field engineers ready to help you solve your motor-drive problems.

M45-4

Wagner Electric Corporation

ESTABLISHED 1891

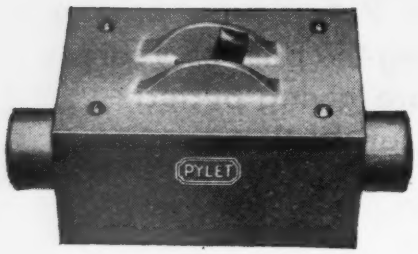
6413 Plymouth Avenue, St. Louis 14, Mo., U. S. A.

ELECTRICAL AND AUTOMOTIVE PRODUCTS

FS and FD Series

PYLETS

The improved conduit fittings



FS and FD Series Pylets are heavy duty types for industrial service and are designed with square corners so as to take all standard switch and receptacle plates. Malleable iron bodies are galvanized and exterior baked finished. The top surface is ground for perfect seating of covers, and cover screw holes are counterbored, providing self-aligning fitting of covers for easy installation. Built in a complete range of types and sizes for all industrial wiring needs. Write for Pylet catalog with complete listings.

THE PYLE-NATIONAL COMPANY

1344 N. Kostner Avenue, Chicago 51, Illinois

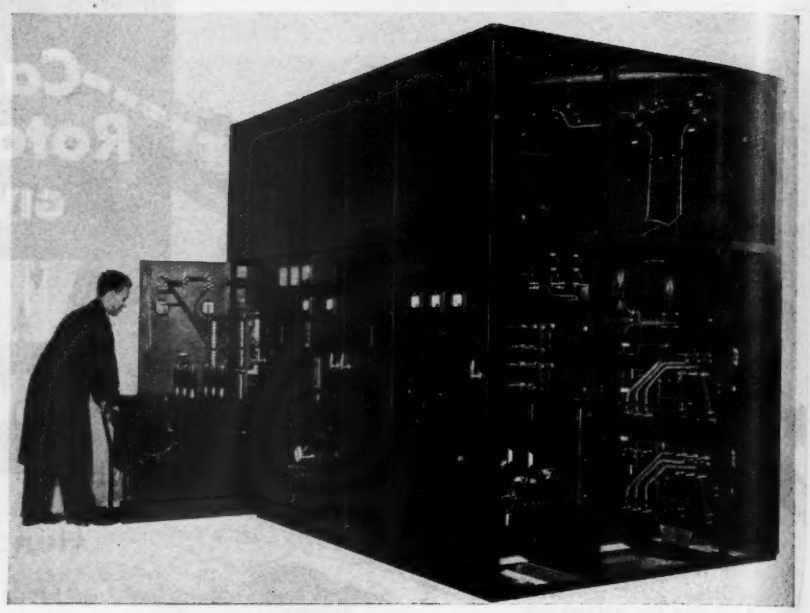


FIG. 13—Metal-clad high voltage synchronous control with two cubicles devoted to the synchronous motor control while the third panel is for d-c. Draw-out type breakers are used in this particular unit.

is desirable. This may be accomplished by the use of disconnecting switches mounted in a separate compartment at the top of the control. Another means is the use of draw out type breakers. Fig. 13 shows a high voltage control, with two panels being synchronous motor control, while the third is a d-c panel. The operator is removing the draw out breaker for maintenance and adjustment.

Braking Applications

In installations like a mill line in a rubber mill there is always the danger of the attendant's hands or clothing getting drawn into the rolls. Synchronous motors lend themselves admirably to the quick stopping that is required, using either the dynamic braking or plugging type of control, both of which are illustrated by the simplified diagrams of Fig. 15.

The dynamic braking system disconnects the stator of the motor from the line and then short-circuits the stator terminals through a braking resistor. Excitation of the motor field is, of course, maintained until the motor comes to rest. The action of the motor is that of a short-circuited generator, so that a powerful force is imposed to stop the motor.

The plugging system connects the motor terminals into full reverse position on the supply line. The motor comes to a stop and tends to rotate in the opposite direction, but is prevented from reversing by disconnecting it from the line the moment it comes to rest. Very quick stopping is afforded by this method. It has the advantage of simplicity and is supplied with a switch without extra expense for reversing duty.

Engineering consideration to the details of synchronous motor control are as important as consideration of the motor drive itself. The results to be attained are a control which smoothly starts the motor and protects it while in operation. Poorly selected motor control equipment can discount the advantages of a good synchronous motor design if proper attention is not given to this important item of the complete drive.

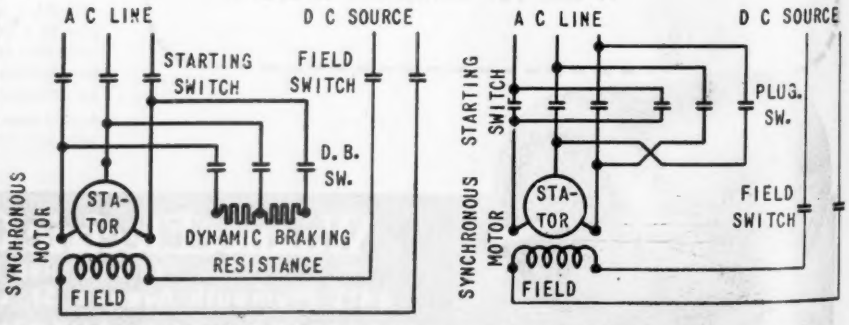
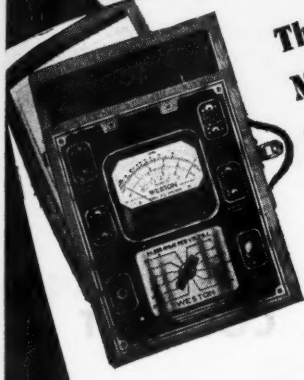


FIG. 14—Simplified diagram showing connections for dynamic braking control (left) and connections for plugging braking control on right.

Simplify TEST PROCEDURE

with these versatile WESTON Test Instruments



The Multi-Purpose, Super-Sensitive Analyzer

(MODEL 772)

A compact and practical wide-purpose instrument with sensitivity of 20,000 ohms per volt, or 1000 ohms per volt, on dc ranges.

Ranges — all self-contained

Voltage, a-c and d-c — 0-1000/250/50/10/2.5.

Current, d-c — 0-10/1 amps. — 0-250/50/10/1 milli-amps. and 100 microamps.

Ohms — Full Scale — 30/3 megohms — 30,000/3000 ohms. Center Scale — 250,000/25,000/250/25 ohms.

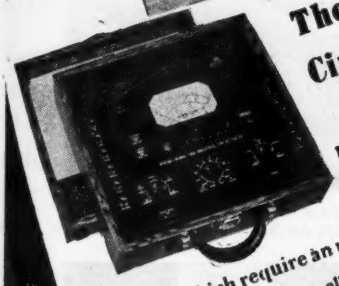
Decibels — −14 to +2, −2 to +14, +12 to +28, +26 to +42, +38 to +54.

(Voltages up to 5000 dc available through use of external WESTON Televerter, Model 766.)

The Direct-Reading, Self-Contained INSULATION TESTER

(MODEL 796)

This compact direct-reading resistance tester eliminates hand cranking and thus makes leakage testing a simple one-man job especially in unaccessable places. Tests up to 200 megohms at test potential of 350 to 500 volts d-c; although, the current at terminals is only a few microamperes. Operates from long life, light-weight batteries. There are no vibrators to replace. Ranges: 0-20-300 megohms full scale; 0-.5-5 megohms center scale. Size 8" x 9⅛" x 8".



The Industrial Circuit Tester

(MODEL 785)

Recognized as the most complete unit for routine maintenance tests, and for testing needs which require an ultra-sensitive instrument.

Ranges all self-contained

D-C VOLTAGE . . . Six Full Scale Ranges of: 1/10/50/200/500/1000 volts (20,000 Ohms per volt).

A-C VOLTAGE . . . Six Full Scale Ranges of: 5/15/30/150/300/750 (1,000 Ohms per volt).

D-C CURRENT . . . Six Full Scale Ranges of: 50 Microamps . . . 1/10/100 Milliamps. . . . 1/10 Amps. (Higher ranges, at half scale reading, with 100 mv. external shunts).

A-C CURRENT . . . Four Full Scale Ranges of: .5 1/5/10 Amperes. (Higher Ranges with external current Transformers.)

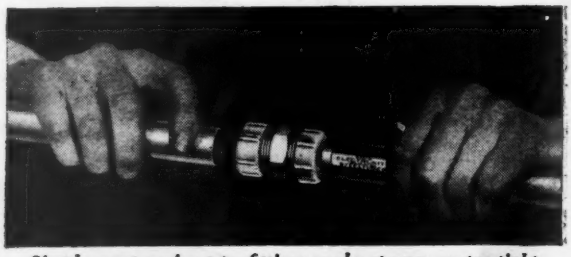
RESISTANCE . . . Five Full Scale Ranges of: 3,000/30,000/300,000 Ohms . . . 3/30 Megohms. Center Scale Values . . . 25/250/2,500/25,000/250,000 Ohms. (Self-Contained Batteries)

With production currently running slightly ahead of war requirements, a limited number of the popular WESTON test instruments shown herewith are available and are offered subject to prior sale. Orders can be placed direct, or with the WESTON representative in your vicinity. Literature available from...WESTON Electrical Instrument Corporation, 578 Frelinghuysen Avenue, Newark 5, New Jersey.

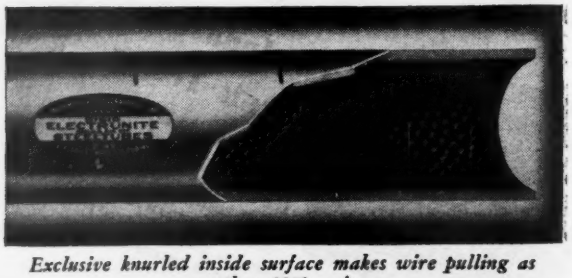
WESTON
INSTRUMENTS

LIKE THE AUTOMOBILE *Electrical Raceways*

IN ELECTRICAL CONDUIT



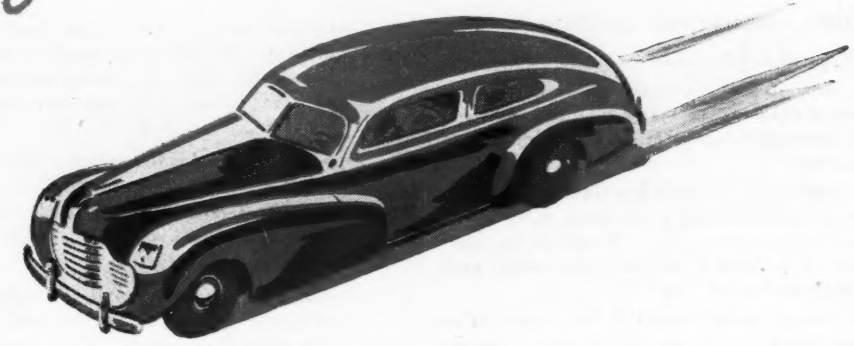
Simple compression-type fittings make strong, water-tight joints in a jiffy . . . end laborious "steam fitting" work.



Exclusive knurled inside surface makes wire pulling as much as 30% easier.

The ELECTRUNITE Bender predetermines accurate bends—is easy to use.

have gone modern, too!



IT PAYS TO BE MODERN WITH SAFE, LOW COST RACEWAYS OF REPUBLIC ELECTRUNITE E. M. T.

Republic ELECTRUNITE E.M.T.—the modern streamlined raceway for wiring—is safe. It is approved by the National Electrical Code—for exposed, concealed or concrete slab construction.

Light in weight, ELECTRUNITE E.M.T. offers adequate electrical and mechanical protection as determined by Underwriter's Laboratories. This weight reduction is made possible because it is threadless—no excess steel is needed to act as a base for threading.

Two easy-to-use, compression-type fittings—coupling and box connector—create strong, water-tight joints which will not work loose even under vibration. In addition, the box connector makes it possible to combine ELECTRUNITE E.M.T. with existing threaded conduit installations and fittings.

Continuous protection against rust and corrosion is furnished by a uniform, tightly-adherent zinc coating. Such protection—unbroken by threads and unmarred by biting pipe wrench teeth—cannot be duplicated with old-style methods.

Because it eliminates tedious thread cutting . . . is quickly and accurately bent in the shop or on the job . . . makes wire pulling easier, ELECTRUNITE E.M.T. enables you to keep jobs moving—*at a profit.*

Yes, ELECTRUNITE E.M.T. is the modern solution to today's problems of safe, low-cost electrical raceway installations in practically every type of building construction. For further details see your local Republic ELECTRUNITE Distributor.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, New York

Republic
ELECTRUNITE E.M.T.
REG. U. S. PAT. OFF.
LIGHT WEIGHT THREADLESS RIGID STEEL CONDUIT

DATA SHEET

D-7

Terms and Definitions Applicable to Electric Circuits and Electronic Tubes

7. ELECTRONIC TUBE DEFINITIONS AND CHARACTERISTICS (Con't)

B. GASEOUS TUBES—THERMIONIC EMISSION

a. Two-element gaseous tube—mercury vapor—Phanotron

—*Maximum peak inverse anode voltage* is the highest instantaneous peak voltage that a tube can withstand in the direction opposite to that in which it is designed to pass current.

—*Maximum peak anode current* is the highest instantaneous peak current that a tube can safely carry in the direction of normal current flow. A cathode ray oscilloscope should be used to determine the actual peak currents for a particular circuit.

—*Maximum average anode current* is the highest value of average output current that can be safely supplied by the tube in the operating direction.

—*Cathode Heating Time* is the minimum time that the filament should be allowed to heat before the anode voltage is applied.

—*Tube Drop* is the potential drop between the cathode and anode when the tube is carrying its rated average current.

—*Pickup Voltage* is the potential that will cause the gas in the tube to break down and conduct current.

b. Three or four-element gaseous tube—Thyratrons

The four-element tube contains two grids. The function of one is to control the discharge and the purpose of the other is, in general, to shield the control grid. The shield grid reduces the electrostatic capacity and the coupling between the anode and control grid. Transients in the anode potential supply, therefore, only slightly affect the control grid potential. This arrangement minimizes the possibility of loss of control resulting from high-frequency transients or steep wave front disturbances that may be imposed on the anode circuit.

—*Maximum peak inverse anode voltage* is the highest instantaneous peak voltage that a tube can withstand in the direction opposite to that in which it is designed to pass current.

—*Maximum peak forward anode voltage* is the highest instantaneous value of voltage that may be applied between the cathode and anode in the direction in which the tube is designed to pass current without causing the grid to lose control.

—*Maximum peak anode current* is the highest instantaneous peak current that a tube can carry in the direction of normal current flow.

—*Maximum average anode current* is the highest average value of current that the tube is rated to carry continuously in the normal direction of current flow.

—*De-ionization time* is the time required under normal operating conditions to clear the space inside the tube of positive ions. The control grid does not have any effect until the tube is cleared.

—*Ionization time* is the time required for a sufficient number of positive ions to be formed around the cathode to allow the maximum peak current to pass through the tube without damaging the cathode.

—*Tube voltage drop* is the cathode to anode voltage drop when the tube is passing current. It may be given in minimum, average, or maximum values depending upon the current.

—*Cathode voltage* is the voltage applied to the filament or heater. (It should be measured at the pins on the base of the tube. Best results are obtained when the cathode voltage does not vary more than plus or minus 5%.)

—*Cathode current* is the average value for the specified cathode voltage.

—*Cathode heating time* is the time required for the cathode to reach the safe cathode operating temperature.

—*Peak grid voltage range* is the highest instantaneous voltage which may be applied safely to the grid with respect to the cathode. (It is usually given in voltage values from the maximum negative to the maximum positive peak value.)

—*Maximum instantaneous grid current* is the highest instantaneous current which the tube is rated to carry to the grid recurrently in the normal direction of current flow.

—*Maximum average grid current*—(after breakdown)—is the highest average current the tube is rated to carry to the grid continuously in the normal direction.

—*Grid current*—(just before breakdown)—is the peak grid current as measured with the grid voltage just sufficiently negative to prevent the tube from conducting. (This current determines the voltage drop across the series grid resistor at the instant of breakdown.)

—*Maximum averaging time* is the longest period over which the anode current should be averaged regardless of the wave form. (This averaging time value is established by the manufacturer for the particular tube.)

—*Maximum condensed mercury temperature* is the highest temperature measured at the coldest spot on the tube, usually the junction of the cathode base and bulb, at which the tube can be operated without danger of arc-back or loss of grid control at maximum voltage and current.

—*Minimum condensed mercury temperature* is the lowest temperature usually measured at the junction of the cathode base and bulb, at which the tube can be operated without loss of emission because of a high voltage drop.

—*Optimum condensed mercury temperature range** is the range of temperature, measured the same as for the maximum or minimum temperature, which will provide the utmost reliability of operation and give the longest tube life.

—*Maximum peak negative grid swing*** is the highest instantaneous negative voltage which may be applied to the grid with respect to the cathode. Because of the relatively high pressure in an inert gas tube, the voltage between the grid and the anode must be maintained at a low value. If too high a grid-anode voltage is applied, the tube will become unstable or may lose control completely.

*For mercury vapor types of tubes

**For inert gas types of tubes

R. B. Immel, Westinghouse Elec. & Mfg. Co.

A BETTER ROTOR
A BETTER MOTOR

ONLY A FAIRBANKS-MORSE MOTOR HAS THE EXCLUSIVE

***Copperspun* ROTOR**

Centrifugally Cast in One Piece and of Copper

It took *years* to develop the Fairbanks-Morse centrifugally-cast, one-piece copper rotor. But it's worth it. Reduced operating costs and longer, more dependable service are the results.

But those aren't the only advantages you get in a Fairbanks-Morse Motor. There's a long list of other features that all add up to *better* service for you. Note the list below. That's why we call it tomorrow's motor today.

Check List of Plus Features

Protected Frame — Dripping liquids and falling particles excluded in any mounting position.

Symmetrical Design — Reversible frame provides for locating conduit box on either side. Bearing arms can be mounted in any one of four positions 90° apart.

Crossflow Ventilation — Another exclusive feature in frames 224 to 365 inclusive. Air moves in both directions, providing a motor of uniform temperature. No hot spots.

Recessed Conduit Box — An innovation for neat installations. Choice of conventional box or frame recess with cover flush with frame.

Balanced Characteristics — Motor rated 40°C with high efficiency and power factor and excellent starting and accelerating torques.

Ball Bearings — Sealed in and protected.

Write for information, Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Illinois.

BUY MORE WAR BONDS

Fairbanks-Morse

A name worth remembering

Diesel Locomotives • Diesel Engines • Generators • Motors • Pumps • Scales
Magnetos • Stokers • Railroad Motor Cars and Standpipes • Farm Equipment

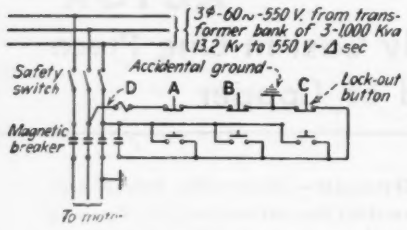
QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published, we pay $5.00.

READER'S QUIZ

CONTROL WIRING

QUESTION 164—We have several long conveyors in our mill, controlled by magnetic switches and pushbuttons. The pushbuttons are regular start and stop type with lock out feature marked "SAFE" when in the locked out position. However, the motors have at times started and nearly caused severe accidents.

The cause of the starting has been traced to the grounding of control wire, as per sketch, at a



point between the station "C" and the holding coil of the magnetic switch.

We have a bank of ground indicating lamps (consisting of five 10 watt, 115 volt lamps in series) from each leg to grounded neutral. These lamps have been disconnected and the magnetic switches will still operate with no metallic return.

We have also tried connecting the coil to ground at point "D" in the sketch instead of the line wire. This is not very satisfactory as the low voltage will cause a magnetic hum, and often drop out entirely.

Repairmen have been instructed to open the safety switch before working on the conveyor, but some of the stations are quite a distance from the safety switch so they frequently use only the lockout buttons.

Is there any way to eliminate or neutralize this condition to make the lockout stations safe?—W.C.M.

A. TO QUESTION 164—The diagram shows a ground on one of the motor leads but there is no notation as to whether or not it is accidental. However, there should be no ground on a three phase delta system. Remove this ground and the trouble will be eliminated.

If this ground can't be cleared, wire the magnetic switch so that the coil is connected to the grounded lead and the start circuit to an undergrounded lead. Then, if an accidental ground occurs, the switch will not operate but a fuse will blow.

Despite all these precautions, the safest way to work on any electrically driven machine is to open the safety switch, remove the fuses, and hang a "keep off" sign on the switch. This takes only a few minutes, but it might prevent loss of life or a very serious accident.—S.S.P.

A. TO QUESTION 164—The isolation of the control circuit seems to be the solution for the prevention of unintentional starts through accidental grounds.

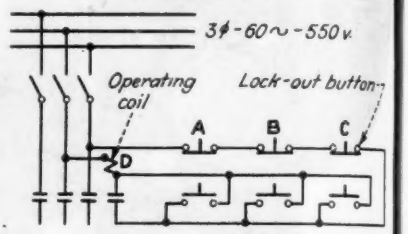
The accompanying diagram accomplishes this with the minimum of wiring change.

Rectified a-c of about 150 volts is used in the control circuit which is totally isolated from a-c lines. The start buttons (with lock-in contact in parallel) are connected to the negative terminal of the plate circuit relay while the stop buttons are series-connected to the positive terminal.

Should one or more grounds develop in the start buttons and one or more grounds develop in the stop buttons a short circuit results. The control circuit being operated on lower voltage keeps grounds to minimum throughout control circuit.—A.C.L.

A. TO QUESTION 164—By making the few changes in wiring as shown in the accompanying diagram, it will eliminate magnetic breaker operation should the lock-out button circuit strike an accidental ground.

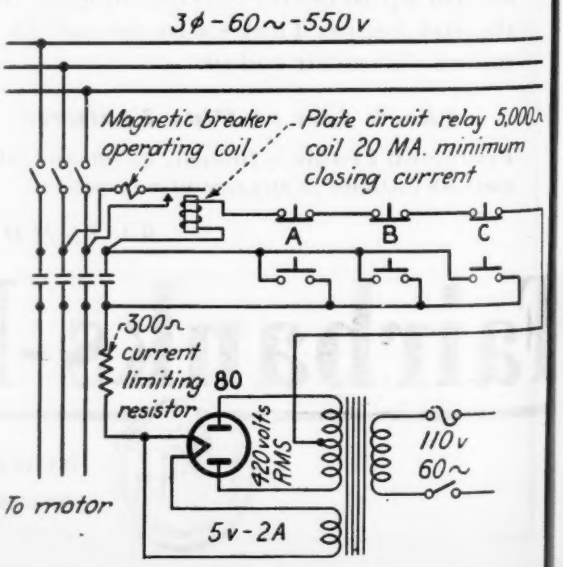
The only possibility of starting by an accidental ground in the control



wires would be between coil D and pushbuttons A, B, and C in diagram, which is not very likely.—C.F.B.

A. TO QUESTION 164—Probably the simplest and most inexpensive way to remedy this trouble would be to remove the ground by replacing the control wires with new ones, taking care that the insulation is not damaged during installation.

A better way to prevent accidental starting in the future would be to add an isolating transformer to the control circuit. If this were done you should replace the 550 volt coil with a



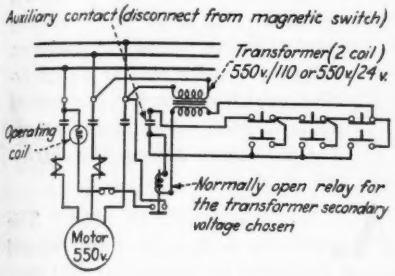
110 volt coil, as standard control transformers have 110 volt secondaries.

If a transformer is added, one accidental ground will not affect the circuit.—C.J.H.

A. TO QUESTION 164—In order to separate the control switches from any ground that might be on the 550 volt system, I have shown a transformer and a relay installed.

The control voltage should be 110 or 24 volts, which will relieve the voltage strain to ground.

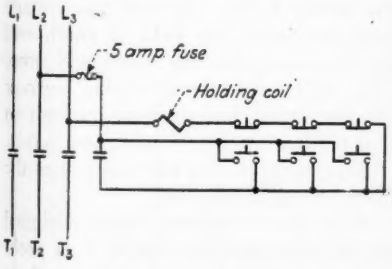
It should be noticed that the connection to the auxiliary switch in the


Auxiliary contact (disconnect from magnetic switch)
Transformer (2 coil) 550v./110 or 550v./24 v.
Operating coil
Normally open relay for the transformer secondary voltage chosen
Motor 550v.

magnetic starter must be removed as the auxiliary switch operates in the low voltage circuit.

If the holding coil of the starter was changed to a 110 volt or 220 volt coil and the coil connected at the points to which the relay coil is connected, the same results can be obtained without using a relay. The secondary of the transformer naturally should be for the same voltage as the holding coil chosen.—B.A.S.

A. TO QUESTION 164—The hook-up shown in the accompanying diagram is really foolproof in a situation like yours. A ground on any section of the control circuit can-



not cause the holding coil to be energized. A ground will blow the 5 amp. fuse and release the holding coil.

However, repairmen should never be allowed to work on the conveyor unless the safety switch is open. That is a basic safety rule.—G.B.

POOR REGULATION OF SHUNT MOTOR

QUESTION 165. We replaced a 10 hp., 600/1200 rpm., adjustable speed compound wound d-c

THE IWI MAN WITH A WISE PLAN *knows that*

MALLORY CAPACITORS

Can take it!

Sturdy and strong, built to give good service for a long time, Mallory Capacitors last.

MALLORY CAPACITORS

are Standardized!

So you can meet any capacitor requirements, for round or square types, with less stock on your shelves.

MALLORY CAPACITORS

are listed in the IWI Blue Catalog, to make selection and purchase easy for you. Send for a catalog today.

INSULATION AND WIRES IWI SERVICE

INSULATION & WIRES, INC.

2127 PINE STREET • ST. LOUIS, MO.

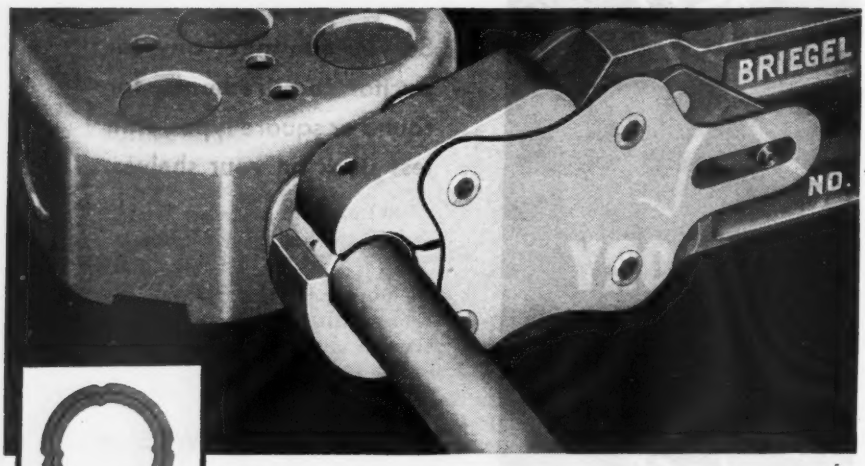
THREAD BOLTS?

This patented dieholder—with large opening below die for instant clearance of turnings—is available for either the Nos. 2 or 3 BEAVER Drophead Ratchet Pipe Threaders. Eliminates torn threads due to chips packing in the die.

Write for Catalog 44

BEAVER PIPE TOOLS

344 DEEN AVENUE **WARREN, OHIO**



Cross section Showing Indentations.

E·M·T·UP THE QUICK WAY
Two Squeezes and it's Set

TWO QUICK SQUEEZES give you Finer, Faster Conduit Connections. B-M Fittings do away with the twisting, turning and tightening of nuts and save you valuable time and materials. Then too, they are stronger, neater and much easier to work with in tight places. Start using B-M Fittings today. Have more satisfied customers—more profits from each job!

(All B-M Fittings carry the Underwriters Seal of Approval)

DISTRIBUTED BY

The M. B. Austin Co., Chicago, Ill.
Clayton Mark & Co., Evanston, Ill.
Clifton Conduit Co., Jersey Cy., N. J.
Gen. Electric Co., Bridgeport, Conn.
The Steelduct Co., Youngstown, Ohio
Enameled Metals, Pittsburgh, Penn.
National Enameling & Mfg. Co., Pittsburgh, Pa.
Triangle Conduit & Cable Co., New Brunswick, N. J.

Prompt Deliveries on Properly Rated Orders

BRIEGEL METHOD TOOL CO. • Galva, Ill.

motor with a 15 hp., 700 rpm. shunt wound interpole motor on a paper slitter. This motor was used with a field rheostat to give a speed range of 2:1. The field current at 700 rpm. was .9 amperes and at 1400 rpm. was .35 amps. Average load on this machine is 50 amperes. Under load with motor at 1400 rpm. the line amperes fluctuated widely from about 5 amperes to 100 amps. and speed of slitter varied accordingly but not in proportion to line amperes. The field current remained steady at this speed. The compound-wound motor always handled this load without any variations in speed or amperes. While I realize this is an excessive speed range for a constant speed motor, what is the reason for the motor acting like this?—H. R. S.

A. TO QUESTION 165. The trouble with your shunt wound motor intended to operate at 700 rpm. and actually run at 1400 rpm. is due to operating with such a weak field. The speed of a direct current shunt motor varies inversely with the field strength. To double the speed it is necessary to cut the strength of the field in two. The field strength is not directly proportional to the field current as the figures show, since raising speed to 1400 rpm. requires cutting the current from .9 amperes to .35 amperes. At lower values of current the field strength is almost directly proportional to the field current. This means that a decrease in voltage causing a slight decrease in field current will cause an increase in speed and this, of course, will require more armature current to furnish the additional energy to drive the slitter faster. Should the voltage increase again the field strength will be increased and the speed will drop. This will result in a smaller current till the speed has dropped enough so that the load comes on the motor again.

Repeating of this process causes the fluctuations mentioned.

With the compound motor designed for wide variation of speed, it is probable that the shunt field strength is always greater (above the knee of the saturation curve), so that even at high speed the field varies much less than the field current.—J. E. W.

A. TO QUESTION 165. The shunt field of the shunt motor is too weak for the load at the high speed. In the compound wound motor, the shunt field holds the maximum speed, and when the motor pulls a heavier load, the extra series field current provides a strong enough field to carry the load while in the shunt motor, field strength is fixed for all loads.—H. S.

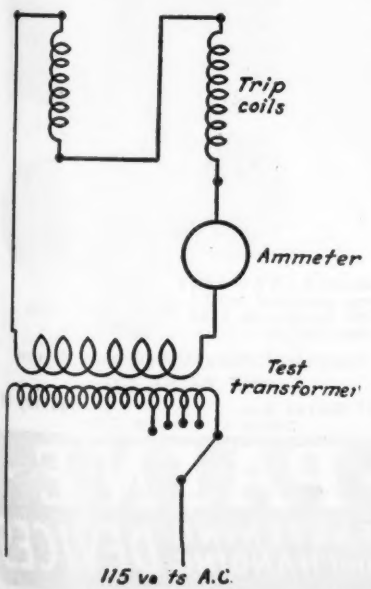
CALIBRATING OVERLOAD TRIP COILS

QUESTION 166 — We are going to rewind two overload trip coils, for a manually operated oil switch. These trip coils were originally operating as series trips, but we wish to operate them from the secondaries of a 400 to 5 amp. current transformer. When we come to calibrate these trips, will it be satisfactory to use a lamp load, and 110 volt a-c.? Will the results be the same as if they were operating from the secondary of a current transformer?—J.A.W.

A. TO QUESTION 166 — Rewinding the overload coils for 5 amperes full load will require more turns so as to give the same ampere turns with 5 amperes as would have been supplied by full load with the series coils. If full load was 400 amperes, you will need $\frac{400}{5}$ or 80 times as many turns. This coil should be wound so as to have a fairly low resistance (about 1 ohm).

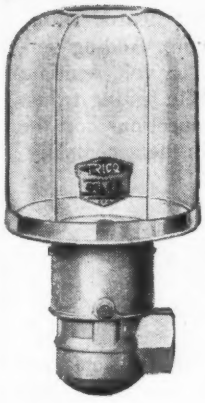
You can calibrate the trips by varying the current through the coil by means of a lamp load and a 110 volt a-c. source. The results will be nearly the same as would be obtained by operation from the secondary of a current transformer if the resistance of the coil circuit connected to the current transformer is kept low. The error should be not over 1 or 2 per cent.—J.E.W.

A. TO QUESTION 166 — The best way to calibrate the new coils would be to connect them to a low voltage transformer and vary the input voltage to get the desired current



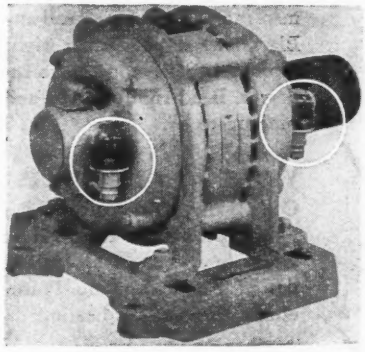
TRICO OILERS

PROTECT BEARINGS
INCREASE PRODUCTION
CUT MAINTENANCE COSTS



Actual performance records prove that better machine performance, improved maintenance and lower operating costs result when TRICO OILERS are installed.

Bearing failures—guesswork—needless shutdowns for hand-oiling—damaged materials and accident hazards are eliminated.



This 5 HP 1800 r.p.m. motor is modernized with TRICO OPTOMATIC constant level OILERS.

Modernize your equipment TODAY and you will always look with pride to your TRICO OILER installation.

WRITE FOR CATALOG

giving complete information on all types available. There's a size and style for every application.

TRICO REG. U.S. PAT. OFF.

TRICO FUSE MFG. CO. Milwaukee 12, Wis.
In Canada—IRVING SMITH LIMITED—Montreal

First Come - First Served

Carbon Brushes may be just as hard to get AFTER the War

Don't wait ! ! ! Many Superior customers are anticipating and ordering now for post-victory use. Materials may be scarce then—and experienced labor, too—for quite a while. Without priorities and with wartime restrictions still lingering, deliveries may be slow . . . Better place your orders right away. If special conditions call for special study on our part, all the more reason for *moving fast.* The Superior Research Department is very busy, but not too busy to investigate your needs thoroughly. Why not write now and give us time to do you a good job?

Get our Bulletin "C"

VE VJ DAY

"Since 1919" SUPERIOR CARBON BRUSHES

SUPERIOR
CARBON PRODUCTS, INC.
9113 GEORGE AVE.
CLEVELAND 5, OHIO

When You Buy a
BENDER
... Check to Make Sure You Get These Features

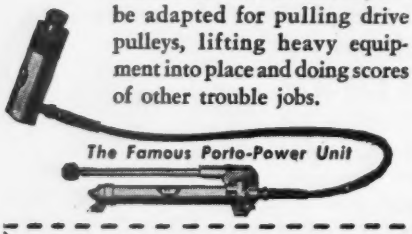
EASY TO GET TO THE JOB
Lightweight and portable, one man can easily carry or roll any Blackhawk Pipe Bender right to the job. Saves time and manpower. Bend rigid conduit and pipe up to 4".

WORK AT ALL ANGLES
Compact hydraulic Porto-Power ram of Blackhawk Pipe Bender works in all directions. Unique design. Avoids kinking. Power eliminates need for heating.

WORK OVERHEAD
All-directional operation and light weight permits work on existing pipe runs.

SIGHT FROM ANY ANGLE
Remote control permits operator to stand in any position necessary to give him full view of job. Blackhawk Benders save need for elbows and couplings and otherwise necessary cutting and threading.

DETACHABLE POWER UNIT *for Extra Utility*
This unit (the heart of the bender) with special available Porto-Power attachments, can be adapted for pulling drive pulleys, lifting heavy equipment into place and doing scores of other trouble jobs.



BLACKHAWK MFG. COMPANY
Dept. P2035, Milwaukee, Wis.
Send full information on your pipe benders.
Name.....
Company.....
Address.....
City..... State.....

BLACKHAWK
Porto-Power
PIPE BENDERS

in the coil. If J.A.W. doesn't have such a transformer, one can easily be rebuilt from a defective 20:1 potential transformer. Generally the 115 volt winding is not damaged, so all that is necessary is to cut off the 2300 volt winding and place from four to ten turns of heavy wire (depending upon volt-ampere rating of potential transformer) around the core. Adding percentage taps to the 115 volt winding will give a very flexible testing transformer. The test connections for the trip coils are shown in the accompanying sketch.—E.J.K.

ENERGIZING SELSYN RECEIVER

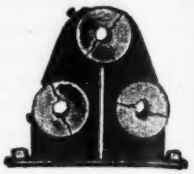
QUESTION 167 — Can your readers tell me how to energize a selsyn receiver without disturbing other receivers or the sender on the same system? Heretofore, I have always stationed a man at each of the several units to hold them from spinning while the entire system was energized, but I would like to know how this could be made a one man job.—G.I.S.

A. TO QUESTION 167—If the selsyn system in question receives three-phase excitation, changing it to single-phase where torque requirements permit may overcome the tendency of the various units to spin when excited. In changing to single-phase excitation, one of the phase windings should be disconnected and the other two phase windings connected in parallel across phase-to-ground voltage. In addition, all units should be excited from the same pair of wires. When energized, all rotors would then be pulled into the nearest satisfied polar position.

It would also be well to check the mechanical dampers, when the rotors are equipped with them, to see that they are in good operating condition, for their failure may create a tendency to spin.—R.G.C.

A. TO QUESTION 167—It is impossible to energize one selsyn on a system without disturbing all other receivers; and since a selsyn system is usually complex, requiring intricate wiring, abnormal behavior should be expected as a result of wrong connections, etc. The selsyn should be checked before installation for electrical zero by connecting as per the accompanying diagram. If the selsyn is properly tagged, the shaft keyway will line up with the zero stamped on the end-bell or dial-face when the a-c volt-

SIMPLICITY PLUS!
New NON-INDUCTIVE CABLE RACK
for
INDUSTRIAL PLANT WIRING



Type D-F 3-Conductor Cable Rack. New Non-Inductive Design. Racks available for Cable sizes from 5/16" to 2⅜".

● Radically different, the new M. & W. Non-Inductive Cable Rack is designed for A.C. or D.C. systems. Racked cables only partially surrounded by metal eliminates any chance of induced current in the rack. Impedance reduced with cables mounted in delta formation. Rack of one-piece construction . . . installation of cables made quick and easy through the use of split bushings.

Send today for Bulletin C-S-51 which illustrates the complete line

THE M. & W. ELECTRIC MANUFACTURING CO., INC.
EAST PALESTINE, OHIO

PAINE
CONDUIT CLAMP
All clamps are rust resistant. Furnished with correct size stove bolt and nut in each clamp to save time counting bolts and nuts for each clamp when purchasing, and to reduce installation time. Manufactured in rigid and thin wall sizes.

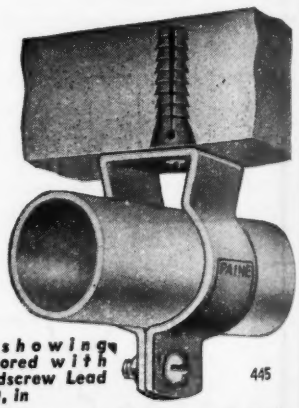
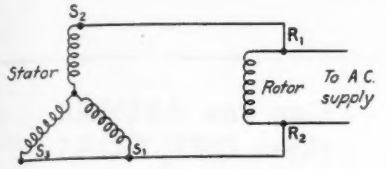


Illustration showing clamp anchored with PAINE Woodscrew Lead Anchor, 950, in 445

Complete Catalog Mailed upon Request
THE PAINE CO.
2961 Carroll Ave. Chicago 12, Ill.
Offices in Principal Cities

PAINE
FASTENING and HANGING DEVICES

age is applied. If the shaft turns elsewhere, re-connect and retag until it does. This will definitely determine R1, R2, and S2. To determine which of the remaining two wires is S1 and which is S3, remove one of these two wires from the circuit. If S1 is opened, the rotor will turn 30 degrees clockwise. If S3 is opened, the rotor will turn 30



degrees counter-clockwise. Now all leads are properly identified. If it is necessary to straighten out selsyn trouble, be sure to make a diagram showing each step taken before moving any lead.—R.E.

A. TO QUESTION 167—In energizing the various units of a selsyn system in which there are multiple units, it is a simple matter to make it a one man job by running a pilot control from a central operating point to the units. Then with a relay circuit, energize all the units at the same time after the system has been placed in readiness. Another way is to obtain all energy from the same source through a main switch, or contactor. Thus, the entire system can be energized at the same time by operation of the main breaker.—L.R.B.

A. TO QUESTION 167—Energizing a selsyn system can be made a one man job by connecting them all to one switch so that all will be energized at one time. For a three-phase system, you can energize first two leads and then the third. In some cases it is practicable to install a flywheel on each selsyn receiver.—H.S.

INTERMITTENT REGULATOR FAULT

QUESTION168—We have been troubled in our plant the last few months by losing the load on our generators because of loss of excitation on the generator fields. We suspected regulator trouble, but to date we have found it impossible to lay the blame on the regulator. Resistances, potential transformers, and all wires have been checked. The exciters have been inspected and cleaned.

We have a type T-A regulator and 3 exciters connected in paralled to the exciter bus. When the a-c voltage drops off,

Extra Long Life

You get more production hours out of your electric motors when you install Johnson HIGH LEAD Electric Motor Bearings. They are correct in design, alloy and tolerance. They slip right into place with a minimum of effort. Properly installed and cared for, they will outlast the motor. Write for new catalogue today. It's FREE.

JOHNSON BRONZE
SLEEVE BEARING HEADQUARTERS
The MOST COMPLETE SLEEVE BEARING SERVICE in the WORLD
490 S. MILL STREET NEW CASTLE, PA.

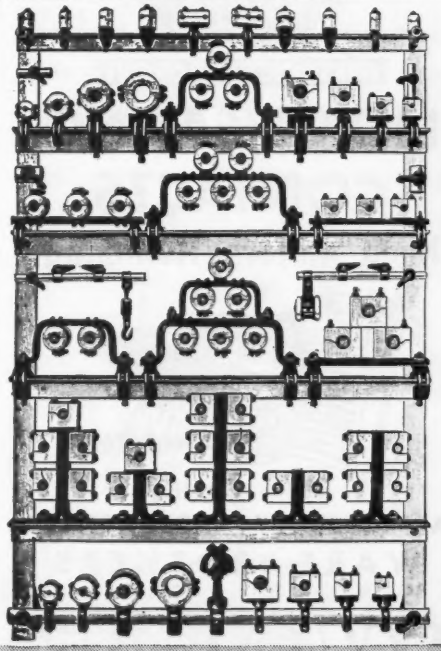
"EFFICIENCY" DEVICES FOR CONDUIT AND CABLE SUSPENSION

• • • A COMPLETE line of SUSPENSION DEVICES!

● For safer, more economical suspension of electrical installations specify EFFICIENCY Devices! Designed to fill a long recognized need, EFFICIENCY Suspension Devices are available for attaching wires, cables, conduit, and pipe to all construction forms and surfaces; structural steel, concrete, brick, hollow tile, or wood . . . without drilling holes! This important advantage makes possible savings not only in time and labor but also in cost of electrical installations.

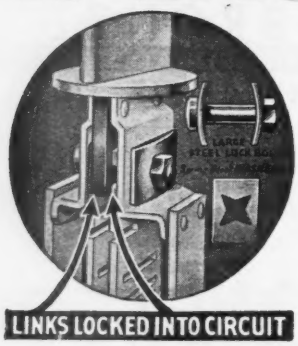
The illustration at the right shows a number of EFFICIENCY Devices mounted as they would be in actual installations. Note that these fittings clamp solidly to columns, girders, angles, pipe or messengers, safely and securely.

Write today for your copy of EFFICIENCY Catalog 38A . . . contains complete construction and application data on all EFFICIENCY Devices.



Efficiency
MANUFACTURERS OF EFFICIENCY ELECTRICAL DEVICES FOR CONDUIT, WIRE AND CABLE SUSPENSION
ELECTRIC AND MANUFACTURING CO.
EAST PALESTINE, OHIO

WARE HI-LAG



NON-HEATING CONTACTS

Keep Motors Humming

100% Quality

APPROVED BY UNDERWRITERS

WARE BROTHERS

4410 W. Lake St. Chicago 4, Ill.

WARE

Renewable

HI-LAG FUSES

it is noted that the main contacts of the regulator stand in the open position calling for a decrease in voltage while the voltage has already dropped off and the load is lost.

Adjustment of the exciter field rheostats will cause the regulator to start operating and the voltage will come back to normal.

This may happen once a week or once a month and it has happened as often as four times in a half hour period.—R.C.M.

A. TO QUESTION 168—It sounds like an erratic short, ground, or open. A method I use to locate trouble of this sort is to attach two boards, each containing up to six sockets across and six sockets down. The first board is normally "on", while the second board is normally "off". Clear low wattage bulbs are used in order to get quick indication.

Then, I make up a diagram which includes an index of suspected parts and terminals. The lamps are then interconnected into the circuits at suspected points of fault in such a way that intermittent shorts, grounds or opens will either light lamps mounted on the normally "off" panel or short out lamps on the normally "on" panel. The two panels are placed at some location in the plant which is always in attendance. Attendants are then asked to report any operation of the lamps, and in particular, to notice which lamps operate and the manner in which they burn, that is, dimmed slowly and then went out, or went "off" suddenly, or went "on" suddenly, etc.

This method has been of great help to me in a number of instances. By experience, I have found that two bulbs in parallel across each test point will guard against normal burnout and loosening.—H.S.

A. TO QUESTION 168—The information given would indicate trouble in the regulator. The fact that the main contacts were found open after the voltage had dropped off and the load had been lost, suggests that just previous to this the voltage had been high so that the contacts were open and that the armature stuck in this open position so that it could not return to the closed position until there was a greater decrease in the voltage.

Try opening the contacts to the limit, then reduce the voltage very slowly. It would be well to check and see that the plungers in the solenoids operate freely and that there are no small pieces of material (possibly magnetic) stuck between the coil and the plunger. A poor contact or varying high resistance in the alternator field circuit might make the condition worse. In such a case the alternator voltage might drop while the exciter voltage is still high and tend to keep the main contact open. The field circuit should be checked carefully for possible bad connections or contacts.—J.E.W.

Can you ANSWER these QUESTIONS

QUESTION P7 Is it practical to attempt to use radio parts such as resistors and condensers for assembling and repairing controls? Standard control assemblies often require a two month wait for delivery while radio parts can be picked up locally.—H.S.

QUESTION Q7 What would be the best method of grounding in an old factory building where the basement floor is cement with no structural iron available except the ½ inch iron rods in the floor. There are a few small water lines but not very handy. Would grounding on these water lines be dangerous to anyone repairing them if the pipe line had to be disconnected? Is grounding to the sprinkler system permissible? Our equipment is 480 volts with around 150 motors running up to individual ratings of 50 hp.—W.L.C.

QUESTION R7—We have three 5000 kw. turbo-generators in our small power plant, which is one of three and which is used to supply a heavy lamp load and a small reactive load. These three units were recently flooded, after which they were removed and returned to the factory for drying. When put back into service, two of the units carried their full loads of 1560 amps. with maximum field excitation. The third unit, however, will not carry more than 1000 amps. with full field excitation. The power-factor meters of the two "good units" read the same, but the p.f. of the defective unit reads about 10 percent higher. The instruments, control and motor have been thoroughly checked with the exception of the internal connections of the rotor. The units are 2300 volt, 60 cycle, 3600 rpm.

Since heavy cable was not available to connect the generator terminals to the 2300 volt station bus, adequate cross-section was obtained by three, three-phase three-conductor cables for the 150 foot run to the bus. Do you suppose the self-inductance of these cables has anything to do with the generator not taking its full share of the load? If not, where is the trouble apt to be?—W.F.K.

PLEASE SEND IN YOUR ANSWERS BY APRIL 1

Power Outlets Speed Plane Assembly

[FROM PAGE 71]

outlets were made to equip every ship on the line and to permit them to remain fixed at designated locations until just before each completed bomber rolled off the line.

Feeding these outlets are standard and hi-cycle overhead trolley ducts installed in parallel on both sides of the final assembly area. At each position along the line decentralized fuse boxes were set up to preclude the possibility of any electrical trouble spreading beyond the point of development. This was a necessary precaution since all power is fed from the main line.

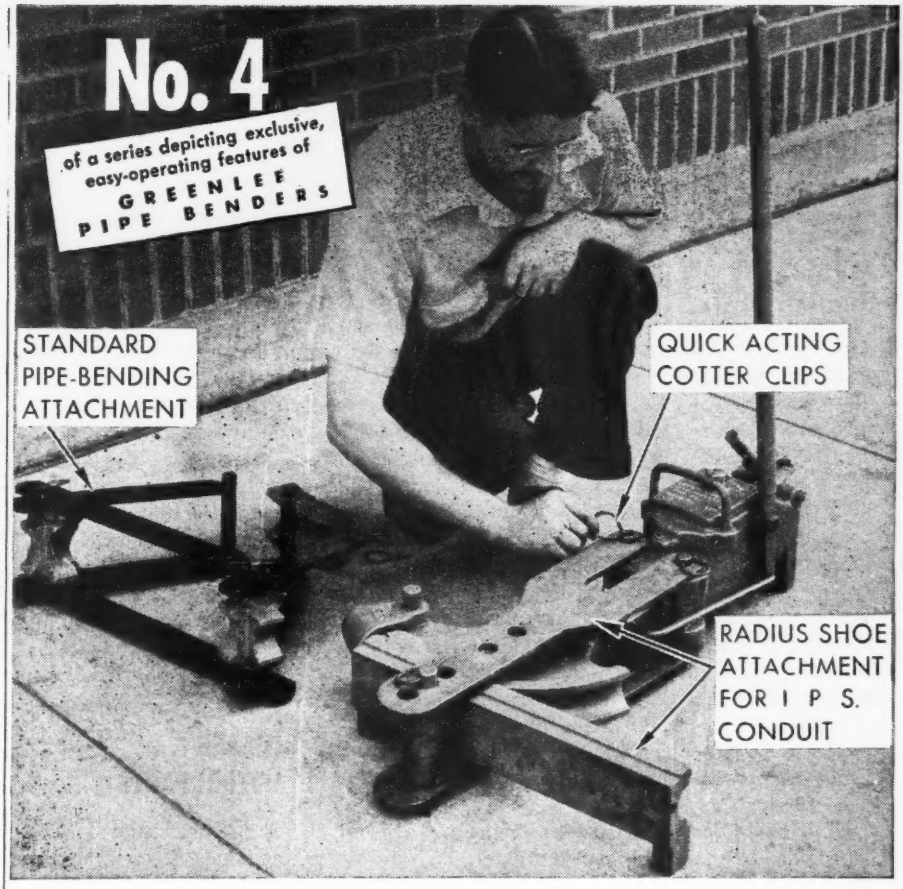
Small electrical tools are plugged into the standard 110 volt, 60 cycle outlets clamped at ten designated locations on top of each ship's wing and fed from standard cycle trolley ducts. This arrangement eliminates the former unsatisfactory kick boxes and the spaghetti-like maze of extension cords. More important is the fact that each workman is now provided with his own outlet easily accessible for standard cycle tools and work lights.

Specially-designed clamps at 18 locations inside the ship, hold the light fixtures, connected in series fashion. Not only has this innovation resulted in providing more evenly distributed illumination but it has also reduced lamp breakage to a minimum.

Hi-cycle, 350-volt, 250-cycle outlets, for the high speed electric tools, are fastened at 15 designated locations on each ship. These are fed from hi-cycle, overhead trolley ducts. Production is greatly increased and maintenance cost reduced through the use of hi-cycle tools, which are much faster and lighter and far more reliable. Altogether, the 15 outlet boxes allotted to each ship will accommodate 75 hi-cycle tools.

Air manifold outlets to power small, air driven tools are fastened along side of each hi-cycle, electric outlet on the ship. Here again, the workman is afforded ready access to the power source from his work station.

Under the North American system, each shift at the end of the work day leaves its tools at a designated location. Outlet boxes, extension cords, air hose and manifolds, remain fixed on each ship until just before it rolls off the lines. The complete temporary power and lighting system is then quickly dismantled and ready for installation in another ship. This innovation alone (saving from 20 to 30 minutes per worker, per shift) has affected a 60 percent reduction in wasted production time.


No. 4
of a series depicting exclusive, easy-operating features of GREENLEE PIPE BENDERS
STANDARD PIPE-BENDING ATTACHMENT
QUICK ACTING COTTER CLIPS
RADIUS SHOE ATTACHMENT FOR I P S. CONDUIT

Quickly adaptable to varying jobs

"ON THE JOB" change-overs to widely differing types of bending projects are made simply and quickly with a GREENLEE Hydraulic Pipe Bender.

Quick-acting cotter clips (an exclusive GREENLEE development) speed switch-over of pipe bending attachments. Thus, with *one* GREENLEE Bender you can bend pipe, rigid and thin-wall conduit, tubing or bus bars — with no loss of time between jobs!

With a GREENLEE Bender *one man* can get smooth, precise bends — of varied types — in but a few minutes. Operation is easy, simple — whatever the bending job, large or small. Get all the facts on how you can save time and money. Write for free catalog 33E describing the complete line of GREENLEE Benders. Greenlee Tool Co., Division of Greenlee Bros. & Co., 1743 Columbia Ave., Rockford, Illinois.

SPECIAL NOTICE: GREENLEE Electricians' Bits are now available in sizes 10, 11, 12.

OTHER GREENLEE TIMESAVING TOOLS FOR ELECTRICAL WORK:

- CABLE PULLERS
- JOIST BORERS
- HAND BENDERS
- RADIO CHASSIS PUNCHES
- PIPE PUSHERS

Get Ready with Greenlee!

REGISTERED TOOLS

GREENLEE

FOR THE CRAFTSMAN

MOTOR SHOPS

ADJUSTABLE SKEIN WINDING DEVICE

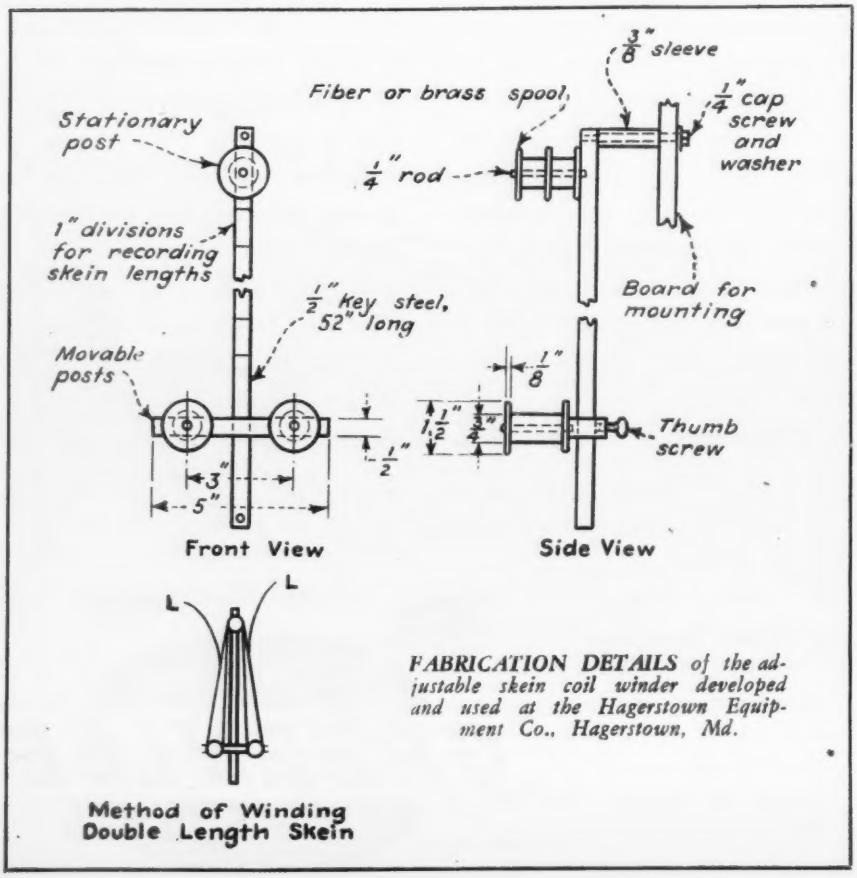
Of the many shop "kink" and production short cut ideas submitted in the 1944 NISA Award Contest, one was devoted to a device for quickly and efficiently winding skein coils—Entry No. 5 offered by the Hagerston Equipment Co., Inc., Hagerstown, Maryland.

As illustrated in the accompanying diagram, the device consists of base bar made of ½-inch key steel, 52 inches long. This is fastened to a mounting board (on wall or work bench) by a ¼-inch cap screw with a ⅜-inch sleeve as a spacer. At the top of the base rod is mounted a double spool made of fibre or brass. This is the stationary post—remaining in the same position for all sizes of skein coils wound.

Adjustment for different size skeins is provided by a movable bracket which slides up and down the key post, being secured at the desired position by a thumb-screw arrangement. One-inch divisions on the key post are used as guides for setting the adjustable bracket for the desired skein length.

Mounted to the 5-inch movable bracket, on 3-inch centers, are two single spools around which the magnet wire is wound. These spools have the same overall length as the double stationary spool at the top. Single length skeins are wound around the top spool and one of the adjustable spools; double length skeins are wound on the three spools as indicated in the diagram.

The Hagerstown Equipment Company finds it saves considerable time and effort by utilizing this simple device—a dividend which every shop is seeking.



FABRICATION DETAILS of the adjustable skein coil winder developed and used at the Hagerstown Equipment Co., Hagerstown, Md.

EFFECTIVE CLEANER FOR SMALL MOTOR PARTS

One of the shop ideas that H. E. Grant of the Tennessee Electric Motor Service, Nashville, left with the Southeastern Chapter, NISA, at a Tampa, Fla., meeting was an effective and inexpensive method of cleaning brass, copper, aluminum and other small parts of electric motors (brush holders, short circuiting devices and other assemblies).

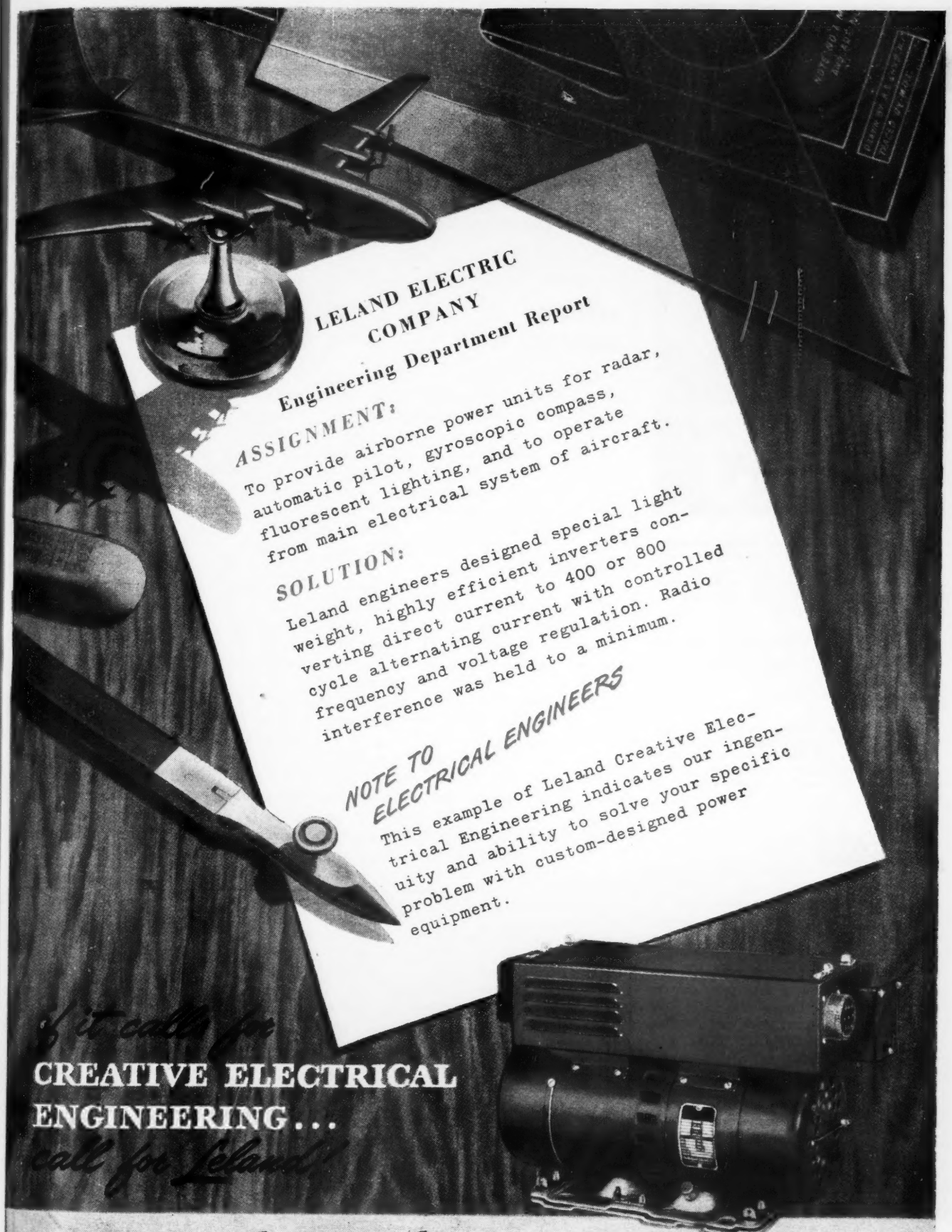
The ingredients required for this process include caustic soda or Oakite, water (hot and cold), nitric and sulphuric acids. Equipment needed is simple and inexpensive—a small two-burner hot plate (preferably gas); two five-gallon metal cans; a two gallon earthenware crock; a sink or small wash-rack equipped with a drain and a cold water faucet with a shower attachment (for a cold water rinse).

The two five-gallon cans are placed on the hot plate, each filled about 2/3 full of water. Five pounds of caustic soda or Oakite is added to one of these containers; the second can contains the water for a hot rinse. Both the caustic soda and water are brought to a temperature of approximately 180 degrees F. (it's not necessary to bring to a boil). About one gallon of nitric acid is poured into the earthenware crock and to this is added about ½-gallon of sulphuric acid.

The process is now ready to function, but the following instructions must be followed:

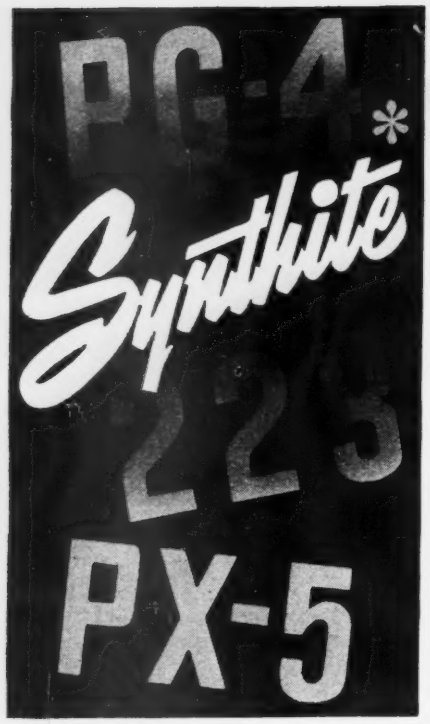
1. String parts to be cleaned on wire and place in the caustic solution for several minutes—*except aluminum. Leave aluminum parts in the caustic only for a very short time* since caustic deteriorates this metal very rapidly.
2. Remove parts from the caustic solution and *rinse in cold water.*
3. Rinse parts in *hot water* and allow to drain.
4. *Dip* parts in the *acid,* remove and place under a *cold water rinse.*
5. Rinse thoroughly in the *cold water shower,* then give them a *second rinse in hot water.* The hot water will leave the parts warm and help them dry very quickly.
6. Thoroughly dry the parts with a blast of compressed air.
7. When the caustic solution becomes weak, add about a double handful of caustic soda (or Oakite) to the solution.

Mr. Grant recommends that this process, be located in a small room of its own, or in a corner of the shop as far away as possible from machinery. The acid fumes—while being used—are quite objectionable and, if too close to machinery, may cause bright metal


LELAND ELECTRIC COMPANY
Engineering Department Report
ASSIGNMENT:
To provide airborne power units for radar, automatic pilot, gyroscopic compass, fluorescent lighting, and to operate from main electrical system of aircraft.
SOLUTION:
Leland engineers designed special light weight, highly efficient inverters converting direct current to 400 or 800 cycle alternating current with controlled frequency and voltage regulation. Radio interference was held to a minimum.
NOTE TO ELECTRICAL ENGINEERS
This example of Leland Creative Electrical Engineering indicates our ingenuity and ability to solve your specific problem with custom-designed power equipment.
If it calls for
CREATIVE ELECTRICAL ENGINEERING...
call for Leland!

THE Leland ELECTRIC COMPANY

DAYTON, OHIO • IN CANADA, LELAND ELECTRIC CANADA, LTD. . . . GUELPH, ONTARIO



PG-4 A Clear Baking Varnish with excellent oil resistance. Thermosetting and possessing a high dielectric strength, this varnish can be thinned with VM&P Naphtha (Benzine) and does not require any special solvent.

PX-5 A Black Baking Varnish adaptable to all types of electrical units, suitable for Formvar, Formex and glass coated wire. Degree of hardness can be regulated by the baking time.

223 A Clear Baking Varnish which provides exceptional bonding properties and heat resistance, making it ideally suited for high speed windings. The hardness of this material permits ease in machining.

*Synthite** . . . a trade name that is gaining more and more recognition throughout the electrical industry, can be furnished in both air drying and baking type varnishes, all formulated to give you more uniform and efficient production. These polymerizing types of varnishes provide a heavier build-up than most conventional grades, affording a high degree of resistance to oil, water, acids and alkalies. There is a grade of DOLPH'S SYNTHITE that will do a better insulating job for you.

* REG. U. S. PAT. OFF.

Write us today for further information and let our Laboratory and Service Engineers assist you in your insulating varnish problems, without any obligation on your part.

Insulating Varnish Specialists

Dolph's

JOHN C. DOLPH COMPANY

168 EMMETT ST., NEWARK 5, N. J.

parts to rust slightly. A small exhaust fan to carry the fumes to the outside will not only eliminate this problem of metal deterioration but will also prevent the shop air from becoming contaminated.

Not only does this process do a thorough cleaning job, but it also enables the reuse of many parts that otherwise would have to be scrapped, Mr. Grant reports. The salvaging of critical parts is particularly important at the present time.

FLEXIBLE INSULATION SHEAR

Cutting insulation for a-c wound rotors—to insulate between phases and, when there is sufficient space, between turns between the point where the leads leave the laminations and where they enter the clips on the end of the rotor—has always been somewhat of a problem. This has been particularly true when the insulation had to be cut to proper radius with the use of a pair of hand scissors.

The problem was taken into hand by Albert Burger, all-around repairman of the Braunlich-Roessle Co., Pittsburgh, Pa., motor repair shop. He developed a simple flexible shear to do the job quickly and efficiently. The cutting elements of the shear consist of ordinary power hack-saw blades with the teeth ground off.

As described and outlined in Entry No. 9 in the 1944 NISA Award Contest, the device consists of the following parts: A wood base "A" (see Fig. 1), one side of which is the arc of a circle with an 11-inch radius; a fixed power hack-saw blade "B" (with teeth ground off) which is bolted to the round edge of the base; a flexible, toothless, power hack-saw blade "C" pivoted to the base and equipped with a handle to complete the shearing elements of the device; a slotted angle iron guide bar "D" for cutting insulation to desired widths; and a wood guide bar "E", mounted to the wood base at an angle of approximately 80 degrees to the horizontal. The completed device is firmly mounted to a workbench. All dimensions are given in the accompanying detailed diagrams shown below.

In actual operation the insulation to be cut is laid on the wood base—the guide bar "E" holding it at the proper angle and the slotted stop "D" holding it at the proper width. The flexible blade "C" is then moved from open position "1" (see Fig. 1) to closed position "2"—the operator pulling the blade down against the fixed blade "B" with a quick snappy movement to assure a smooth cut on the insulation (the shearing action of the two blades coming together producing the cutting medium).

Experience proved that a radius of 11 inches for the round edge of the wood base (to which the fixed blade is mounted) provided the proper radius for insulation to be used on almost any normal size rotor. Also, the 80 degree angle at which the wood guide bar is mounted proved best to get the proper angle for cutting the insulation to meet the majority of requirements.

Formerly considerable time and trouble was involved in cutting this particular type of insulation with hand scissors. With the new cutter this chore now requires only a few minutes and does a much better job.

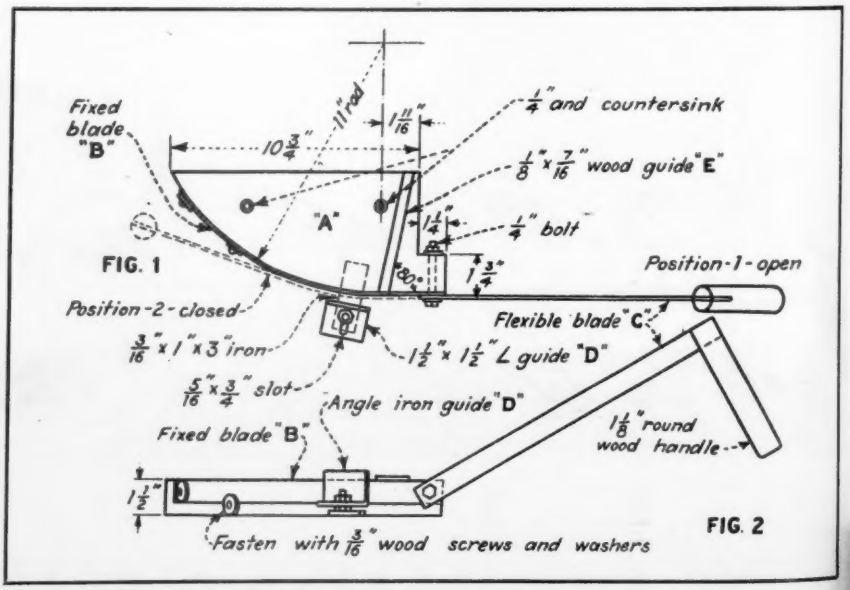


FIG. 1—PLAN VIEW of the flexible insulation shear developed at the Braunlich-Roessle Co., shop in Pittsburgh. Detailed dimensions are shown. Fig. 2—Elevation of new cutting device which reduces insulation cutting time to a minimum.

PORCELAIN PROTECTED WIRING SYSTEMS

ADDITIONS AND ALTERATIONS TO HOMES TO CREATE LIVING UNITS FOR WAR WORKERS IS BEING URGED . . . . .

More than 50 years of usage for industrial, commercial, and residential wiring has demonstrated the adequacy, permanency, and economy of porcelain.

As the need for increased living quarters for war workers grows, property owners recognize the opportunity to remodel their homes, and they are being urged to do so. This property improvement — which in many cases was long contemplated but put off — now becomes an immediate paying proposition.

This movement to reconvert homes so as to add living quarters brings new wiring installation jobs to contractors. PORCELAIN PROTECTED WIRING SYSTEMS make it easy to provide remodeled homes and attics with modern electrical facilities.

Considering the many benefits you can give these customers, plus the benefits to yourself, it's but good business to sell PORCELAIN PROTECTED WIRING SYSTEMS.

- **Complete Insulation**
- **Full Protection**
- **Short Proof**
- **Shock Proof**
- **Rust and Corrosion Resistant**
- **Permanent**
- **Adequate**
- **Economical**
- **Maximum Current Capacity Ratings**
- **Takes Standard Devices and Fixtures**
- **Meets Future Load Increase**
- **Allows for easily made Alterations and Additions**

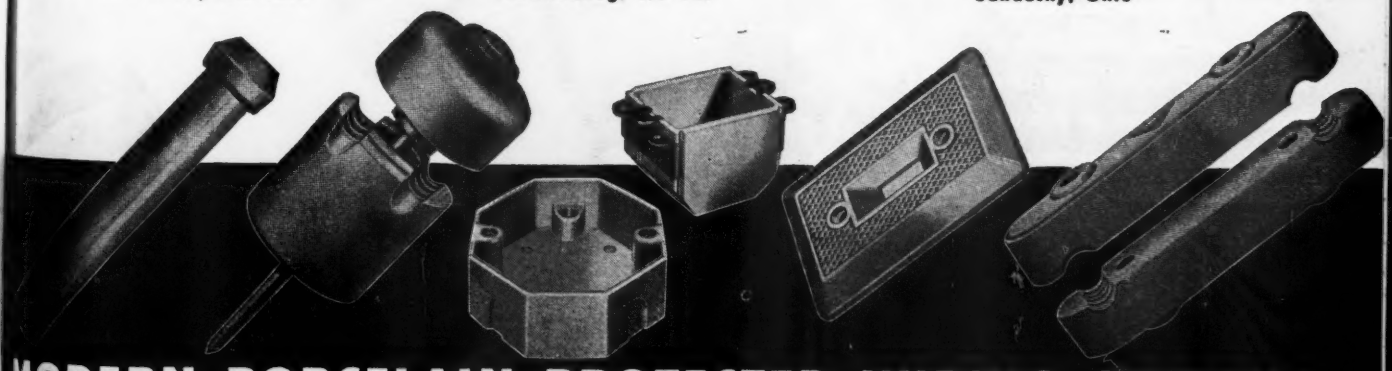
★ ILLINOIS ELECTRIC PORCELAIN CO.
Macomb, Ill.

★ PORCELAIN PRODUCTS, INCORPORATED
Findlay, Ohio

★ SPECIALTY PORCELAIN WORKS
East Liverpool, Ohio

★ SUPERIOR PORCELAIN COMPANY
Parkersburg, W. Va.

★ UNIVERSAL CLAY PRODUCTS COMPANY
Sandusky, Ohio

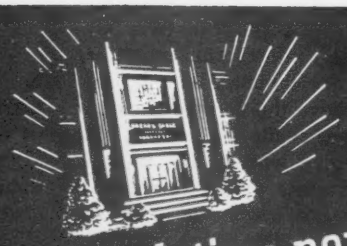


MODERN PORCELAIN PROTECTED WIRING SYSTEMS

SEARCH IN

Here, the moisture-permeability of a synthetic is tested, over a time period, under conditions equivalent to years of difficult service...one of a multitude of separate explorations.

SYNTHETICS



Here, new and surer insulating performance is the goal of a great Research Laboratory.

How most effectively to use the new materials? Which synthetic polymer is best for insulation in dampness? How improve the vulcanization of butyl rubber? How get both high tensile strength and low temperature flexibility in Buna S? . . . In the General Cable Research Laboratory, most completely equipped and manned institution in the world devoted exclusively to wires and cables, a tireless group of scientists is seeking and finding the answers to a host of urgent, practical questions. The work being done opens new vistas of product serviceability in many fields.

GENERAL CABLE CORPORATION

Manufacturers of Bare and Insulated Wires and Cables for Every Electrical Purpose

MODERN LIGHTING

FLUORESCENTS FOR FOUNDRY MOLD INSPECTION

Lighting in the conventional foundry is frequently quite inadequate. This is primarily due to the difficulty of penetrating the haze in the atmosphere of such a department and the inability to keep the fixtures sufficiently clean to efficiently utilize the lighting system. There are some phases of foundry work, however, where good, high intensity lighting is a necessity. These are at the mold machine and in the mold inspection department.

At Chrysler Corporation's Dodge-Chicago plant aluminum foundry mold department the seeing tasks are of a critical nature. The molds are made of dark sand. In the casting of aluminum cylinder heads for the B-29 superbomber engines manufactured in this plant, the molds have numerous depressions for the cooling fins on the heads. Good lighting is needed and fluorescent units provided the answer.

At the molding machine, sand is poured into the mold box and surrounds a model cylinder head mounted therein. The molding machine then vibrates and packs the sand into a solid mass. After the mold is removed from the box, the fins of the model cylinder head are cleaned of any sand particles that might have clung to them. Compressed air is used. To provide adequate lighting for this chore, two, two-lamp, 40-watt, fluorescent units are used. They are mounted side-by-side and 10 feet above the floor to clear the the sand hopper riddle (screen). These four 3,500 degree white lamps in their industrial reflectors provide an intensity of 40 foot-candles on the mold box (3-ft., 6-in. above the floor), enabling operators to quickly do a thorough job.

After the molds are baked and come out of the oven, they are thoroughly cleaned and carefully inspected before proceeding to an acid spray booth, a second inspection and a spray dry oven. Here again, good lighting is necessary to enable the inspectors to see all depressions in the mold. Two parallel rows of two-lamp industrial fluorescent units—three fixtures per row—are used. Each row is mounted 8-ft., 6-in. above the floor and directly over the conveyors. Average illumination intensity at conveyor level (24-inches above the floor) is from 50 to 60 foot-candles. Here, as in the mold machine installation, 3,500 degree white lamps are used. Net result is that a better quality cleaning and inspection job is done on the molds than could have been accomplished without this high-intensity concentrated illumination.

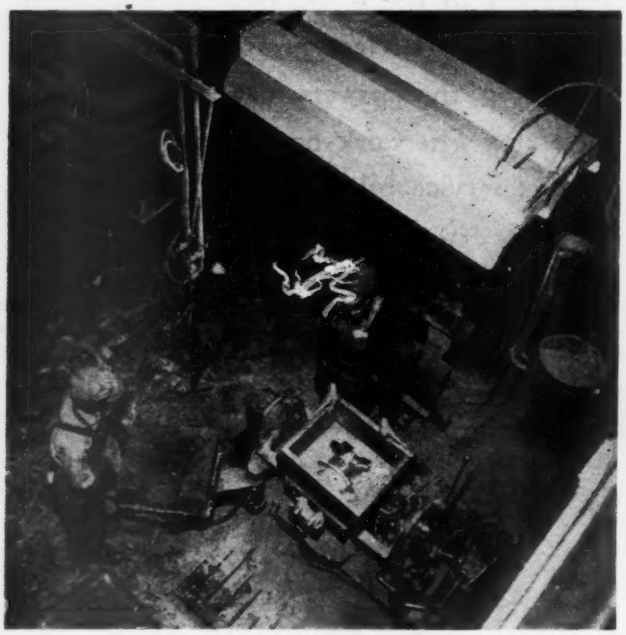
SHELLS INSPECTED UNDER 110 FOOT-CANDLES

With foxhole pleas for more ammunition, more heavy artillery shells, and other items of destruction ringing in their ears, ordnance plant workers are stepping up production to meet predicted demands.

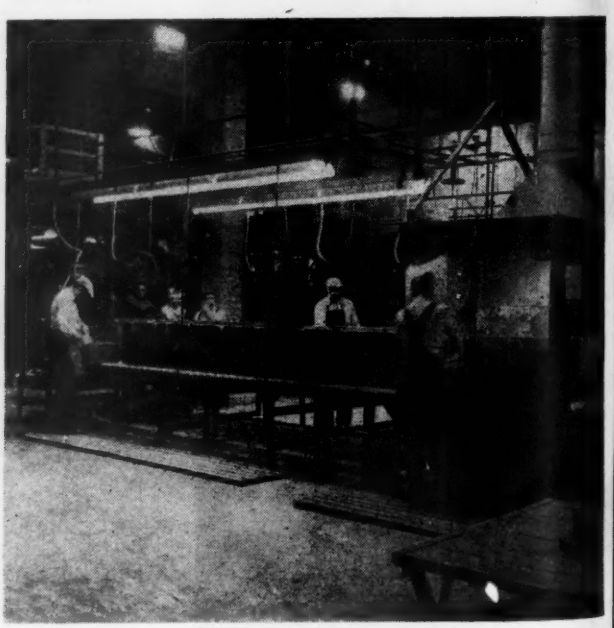
At the Bridgeport Brass Ordnance Plant, Indianapolis, they too are stepping up munitions production. Here brass alloy is heated, rolled, extruded and worked to produce materiel of war. It is a sight for troubled minds to see the thousands of 105 mm. shell cases being produced at this plant.

A vitally important phase of any production system is inspection. A bottleneck in this department can never be tolerated or else the labors of the men at the rolls, hot mills, extrusion machines, and the women at the punch presses and other machines will go for naught in their attempt to maintain top speed production.

Bridgeport Brass Company's answer to the prevention of bottlenecks in the inspection department is the best possible lighting for the task at hand. After leaving the heat treating department in this plant, the 105 mm. shell cases travel on a belt conveyor which winds itself through the inspection de-

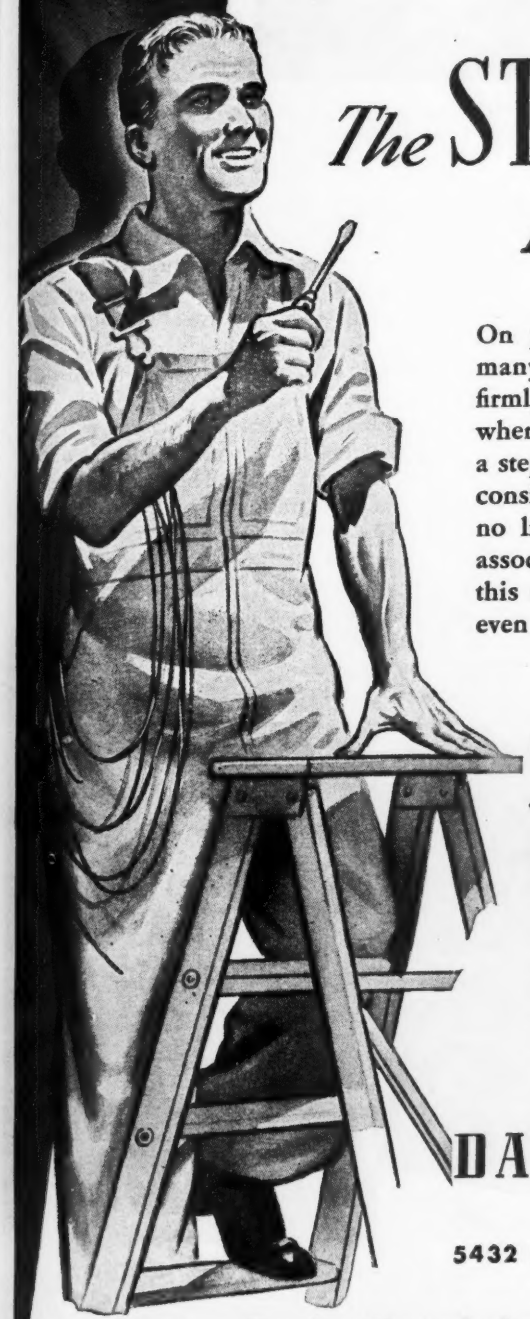


***PUNCH OF LIGHT** of a cool evenly distributed quality is provided by fluorescent units over this mold machine. Workers can easily see to clean body and fins of cylinder head model before again packing mold box with sand.*



***MOLD INSPECTION,** following baking process, proceeds under a blanket of 50 to 60 foot-candles of fluorescent lighting. Cleaned and inspected molds then get an acid spray and a final drying prior to its use in molding.*

it's easy to see when it's "Day-Brite"



The STEPS that Lead to Profit

On present and postwar fluorescent installations, many Contractors, Wholesalers and Dealers are firmly lined up with the quality that's easy to see when it's Day-Brite.... Their judgment makes this a step in the right direction—they know the quality consistently built into Day-Brite fixtures has added no little to the reputation and profit of everyone associated with this complete line. Also, they know this same quality is a business asset that will have even greater value in the days to come.

The **KINGSWAY**
(pictured above)

• Attractively styled for unit or continuous-run surface mounting. End die castings designed to create over-all luminous appearance. *Write for Kingsway Bulletin F-48,* complete with easy-to-read, easy-to-understand engineering and dimensional data.

Consult your Nearest Day-Brite Engineering Representative

Day Brite LIGHTING FIXTURES

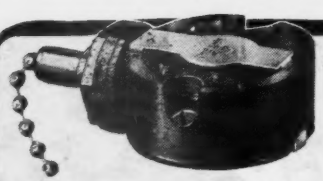
DAY-BRITE LIGHTING *Incorporated*

5432 Bulwer Ave. St. Louis 7, Mo.

THE SIGN OF *Quality* LOOK FOR THIS LABEL

TMs Reg. U. S. and Foreign Countries

Nationally distributed through all leading electrical supply houses



No. 41-B Actual Size

McGILL

LEVOLIER SWITCHES

FOR INDIVIDUAL CONTROL OF LIGHTS AND MOTORS

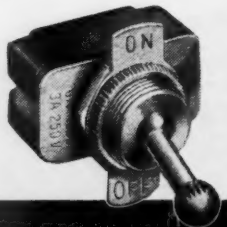
Levolier Switches are especially adaptable on variable speed motors — are widely used on ventilating fan installations, sign flasher boxes and transformer boxes, whose control is often otherwise inaccessible.

Every individual lighting control requirement in fixtures, canopies, conduit boxes and Flourescent lighting applications can be met with a Levolier Switch.

Following are listed a few of the Levolier Switches available. There is an extra margin of safety built in every Levolier Switch.

No. 41-B—6 Amp., T-rating, 125 V., Single Pole.
No. 201—3 Amp., 125 V., 2 circuit.
No. 301—3 Amp., 125 V., 3 way.
No. 400—4 Amp., 125 V., single pole, 3 speed.
No. 402—6 Amp., 125 V., 3 speed.
No. 1010—10 Amp., T-rating, 125 V., Single pole.
No. 1020—10 Amp., T-rating, 125 V., 2 circuit.
No. 265 — 6 Amp., 125 V., D.P.D.T., 1 on and 2 off.
No. 276 — 6 Amp., 125 V., D.P.S.T., on-off.
No. 25—6 Amp., 125 V., Toggle Switch, S.P.

See your dealer or write for complete data

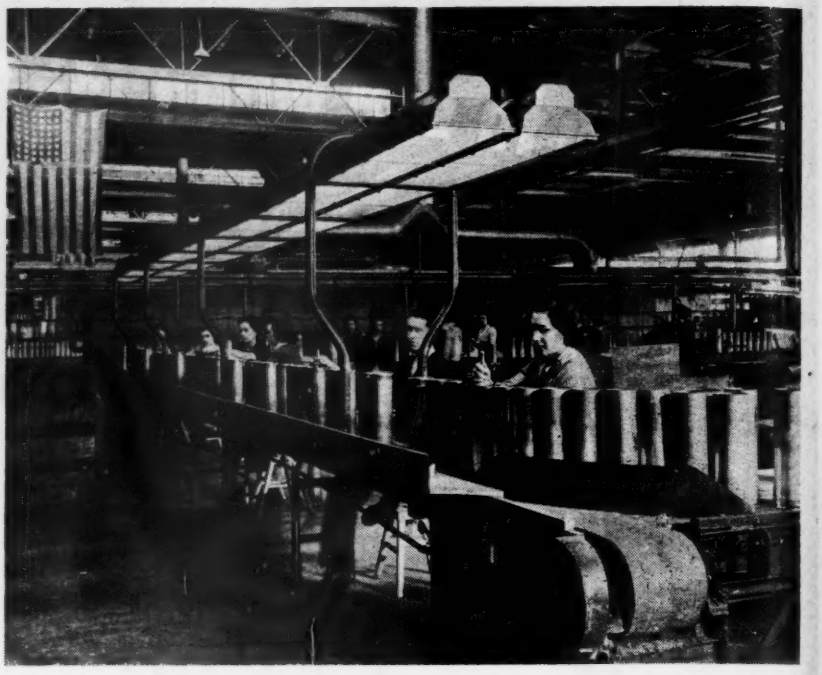


No. 25 Actual Size.

McGILL MANUFACTURING COMPANY, INC.

Electrical Division

VALPARAISO, INDIANA



***HIGH INTENSITY LIGHTING** speeds 105 mm. shell case inspection. Shells pass under a 110 foot-candle blanket of fluorescent illumination on their way to the shipping department.*

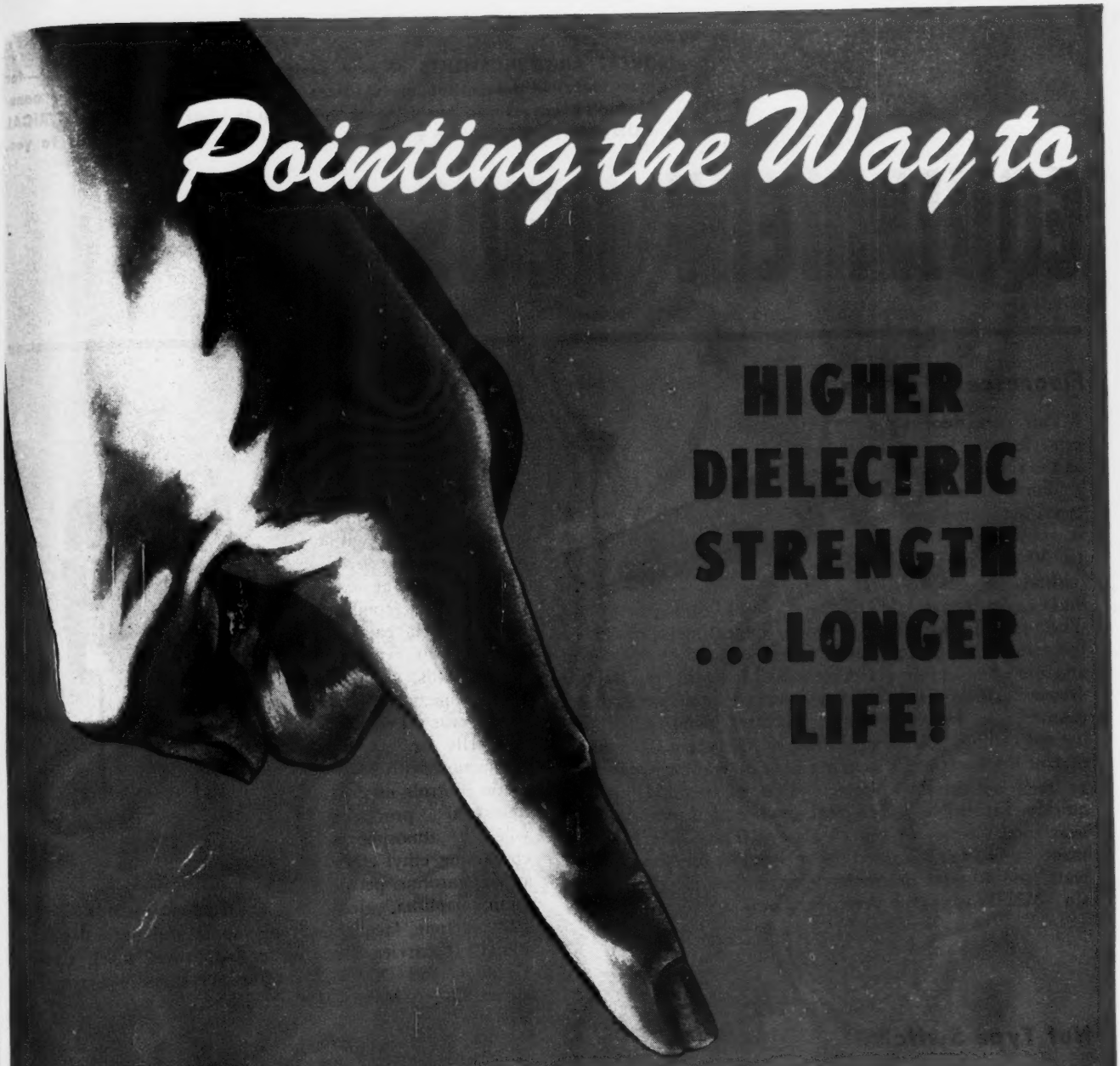
partment to the packaging and shipping department.

While travelling through the line of inspectors, the shells pass under a concentrated blanket of high intensity fluorescent lighting. This is provided by a twin row of glass enclosed, industrial type fluorescent units—each fixture containing two, 40 watt, 3500 deg. white fluorescent lamps. The units are suspended 42 inches above the conveyor belt by an off-set standard mounted to the inspection table.

Lighting intensity at the working plane—the shell case—measures 110 foot-candles; at the conveyor belt, 82 foot-candles. A total of 16, 2-lamp, industrial fluorescent units provide this intensity along a 45-foot section of conveyor. As the shell cases move in front of the various work stations—at a speed approximating 17 feet per minute—they are carefully inspected for flaws and closely checked with gages for compliance with the specified tolerances.

Employees are well pleased with the exceptionally good lighting under which they work. They experience no undue eye fatigue while carrying out their critical seeing tasks. The efficiency of the lighting is evident by the fine record that Bridgeport Brass has made and is making in the production of 105 mm. shells for the armed services.

***DESIGN FEATURES** of the totally enclosed motor are highlighted by H. Fredericks (left), WESCO, Milwaukee, while maintenance electricians Paul Lehmann and Leonard Hanson listen at the recent Industrial Electrical Exposition sponsored by the Electrical Maintenance Engineers of Milwaukee.*



The PRODUCT WITH A PEDIGREE
THE P.D.GEORGE CO.

PEDIGREE
INSULATING VARNISHES

Laboratory-tested . . . proven in service . . . first choice of the entire industry. Pedigree Varnishes are designed to do the job better . . backed by a quarter-century of experience.

Distributed by
INSULATION MANUFACTURERS CORPORATION
INSULATION & WIRES INCORPORATED
TRI-STATE SUPPLY CORPORATION

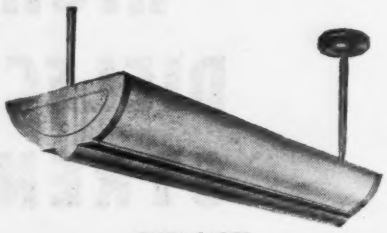
Manufactured by
THE P. D. GEORGE COMPANY, ST. LOUIS, U. S. A.

THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising departments, tell them in what issue of ELECTRICAL CONTRACTING you saw the item and they will send full details to you.

EQUIPMENT NEWS

Fluorescent Fixture

This new fluorescent fixture known as the Guth Cadet is a luminous-indirect type luminaire and is suspended 24 in. to 30 in. in individual or end-to-end arrangement.

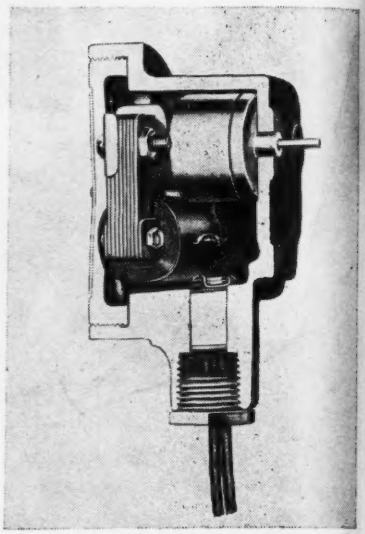


GUTH CADET

The translucent cream-white deflectors deliver in the ratio of 90 percent upward and 10 percent downward, and off-white ceilings are recommended with the lighting system for best results. Fixture surfaces are less than one candlepower per square inch. Fixtures blend in with the lighted ceiling. The illumination on the vertical simulates that of the horizontal, insuring ease of reading on inclined as well as on flat planes. Pen or pencil lines are quickly discernible due to total absence of direct glare and near total absence of reflected glare. The Cadet fixture is made in 48 in., 60 in. and 96 in. lengths, for 40-watt, 100-watt, and 40-watt fluorescent lamps. The Edwin F. Guth Co., 2621 Washington Ave., St. Louis 3, Mo.

Explosion-Proof Motor

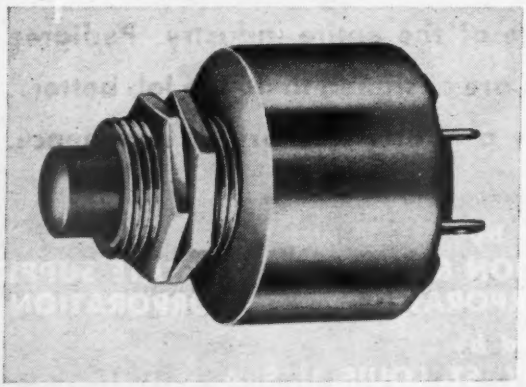
A new explosion-proof electric motor has been developed. It is totally enclosed in a bronze casting with removable screw cover and adapted for explosion-proof conduit mounting. It can be supplied in various shaft speeds, voltages and frequency. This motor was developed primarily for use in connection with automatic controls used in industrial processes where atmospheres containing ethyl ether vapor, gasoline, petroleum, naphtha, alcohols, acetone, lacquer solvent vapors and natural gas are found. It carries Underwriters' approval label, Class 1, Grade C and D, for hazardous locations. Warren Telechron Co., Ashland, Mass.



TELECHRON MOTOR

Nut Type Switch

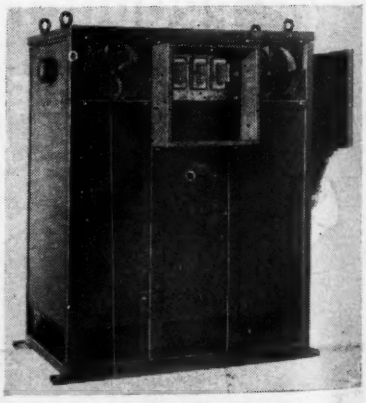
A new nut type switch with a double break feature for panel mounting applications is announced. It is recommended where compactness and ruggedness are required in a limit switch. Case is of cadmium plated brass with a threaded sleeve 15/32-32, carrying two locknuts. Normally open or normally closed circuits. Rating is 15 amp. at 115 volts a-c. Switch is made in two pressure ranges of 10-15 oz. and 16-24 oz. Diameter is 29/32 in. Pretravel approximately 1/32 in., overtravel 1/64 in. Acro Electric Co., 1338 Superior Ave., Cleveland 14, Ohio.



ACRO SWITCH

Transformer

Designed for installation in limited space indoors, this new dry type transformer is equipped with fans for accelerated air cooling. The transformer insulation is Class B, NEMA standard for 80 deg. C. temperature rise, and is composed entirely of inorganic materials such as fiberglas, mica, etc. Fans are thermostatically controlled and operate quietly. Terminals and attached switches or fusing are positioned in accordance with users specifications. Available in ratings up to 1,000 kva., three phase or single phase, and voltages up to 4,800. The Standard Transformer Co., Warren, Ohio.



STANDARD DRY TYPE TRANSFORMER

When Laytex-insulated wire first reached New Guinea, the natives were puzzled about its purpose. So were the inhabitants of other lands—from the Solomons to Mongolia.

For Laytex has gone into many, many regions where no wire had ever gone before. Under arctic cold, steaming tropic heat, the shattering shock of heavy explosions, Laytex performs better than was ever expected of any wire.

The entire output of Laytex Wires and Cables goes to fill the needs of war. But in a not-too-distant future the advantages of Laytex will be available for a long list of important home services... Buildings, Police and Fire Alarms, Communications, Signalling, Power, Control, and many more.

Rubber Insulation at Its Best

U.S. Laytex

ELECTRICAL WIRES AND CABLES

Serving Through Science

UNITED STATES RUBBER COMPANY

1230 SIXTH AVENUE, ROCKEFELLER CENTER, NEW YORK 20, N. Y. • *In Canada:* DOMINION RUBBER CO., LTD.

4 steps to Better Postwar Commercial Lighting

The prior claims of war production are a necessary limitation on all activities looking to the development of postwar markets. Within those limitations, which all of us recognize, the lighting industry has an obligation to prepare now for its share in the task of stimulating postwar business activity and providing postwar jobs. Commercial lighting will be the spark—hence the program outlined on these pages.

"To make G-E Lamps STAY BRIGHTER LONGER" The constant aim of G-E Lamp Research

1 G-E SPONSORS NEW LIGHTING IDEAS

A score of the nation's outstanding architects and industrial designers have been commissioned by G-E to suggest creative new lighting ideas for postwar commercial establishments. Fixture manufacturers already are at work to put many of these ideas into attractive new fixtures that will add to your postwar lighting profits.

2 G-E PROMOTES NEW LIGHTING MARKETS

Two out of three storeowners are planning to modernize their lighting. They want lighting that says "Come in and Buy!" New G-E Mazda Fluorescent Lamps will make higher standards of store lighting easier to sell. The new lamps will include both slimmer, longer tubes and circular shapes.

3 G-E DEVELOPS NEW LAMPS

New G-E Mazda Fluorescent Lamps will make higher standards of store lighting easier to sell. More than ever before the lighting of the postwar store will say "Come in and Buy!" New G-E Fluorescent Lamps will include both slimmer, longer tubes and circular shapes.

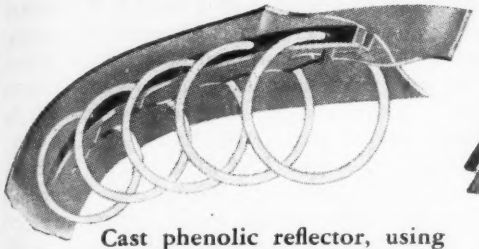
4 G-E WILL HELP TRAIN YOUR SALESMEN AND SUPPLY YOU WITH TESTED SALES AIDS AND DIRECT MAIL

Sales help where you need it! Training salesmen will be a job that needs doing quickly and well. General Electric's training program for lighting salesmen will be simple, interesting, and flexible enough to meet the needs of one man or a hundred. Direct mail sent out over your signature will help you line up business prospects, and sales aids will clinch orders. All this material will be available as soon as conditions permit.

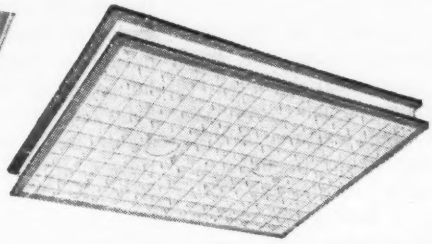
BUY WAR BONDS AND HOLD THEM

G-E MAZDA LAMPS

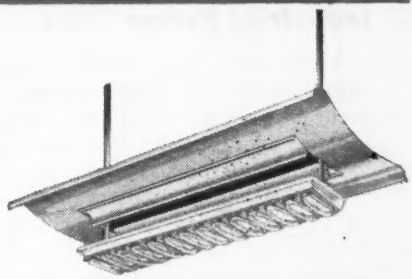
Hear the G-E radio program "The G-E All-Girl Orchestra", Sunday 10:00 p. m.



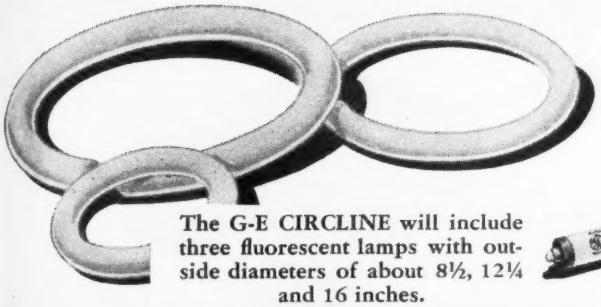
Cast phenolic reflector, using circular fluorescent lamps, designed to direct store traffic.



Fluorescent unit with adjustable spotlights for highlighting displays.



Four-lamp fluorescent luminaire suggested for grocery store.



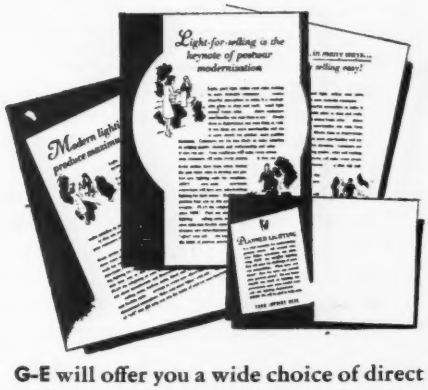
The G-E CIRCLINE will include three fluorescent lamps with outside diameters of about 8½, 12¼ and 16 inches.

The G-E SLIMLINE—four new slimmer fluorescent lamps up to eight feet in length.

UNIT No. 1
G-E-LaSALLE TRAINING in
UNIT No. 2
G-E-LaSALLE TRAINING in
LIGHTING FOR SELLING
This prepares the salesman to apply the fundamentals covered in Unit No. 1 to the great store lighting market. The two texts in this unit show why better light means better retailing and how to sell it.
—$.500

Leading training organization is helping plan G-E's training program.

New sales aids will help your salesmen make persuasive demonstrations.



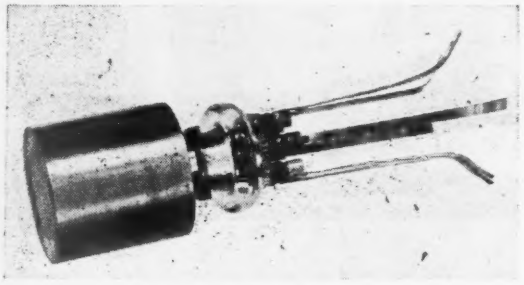
G-E will offer you a wide choice of direct mail to reach store lighting prospects.

GENERAL ELECTRIC

EWT, NBC: "The World Today" news, Monday through Friday 6:45 p. m. EWT, CBS; "The G-E Houseparty," Monday through Friday 4:00 p. m. EWT, CBS.

Industrial Power Tube

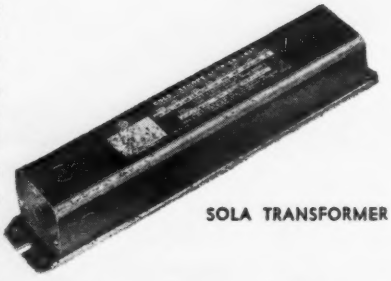
A new power tube, first in a series especially designed for industrial use in high-frequency heating equipment, has been developed. This new tube, designated F-5303, is supplied with 6-in. flexible copper leads permanently secured to the tube terminals. Some of the other features of this tube are its sturdy, conservatively spaced filament and grid elements, and an absence of ceramic insulation, both internal and external. This makes it suited for use in electronic heating equipment that must withstand the shocks and vibration commonly encountered in manufacturing plant operations. Rated at 3500 watts input, the power tube operates at full ratings at frequencies up to 50 megacycles. Maximum ratings are: d-c plate voltage 3500 volts, d-c plate current 1.0 amp. plate dissipation 1200 watts. The filament current is 27.5 amp. at 11 volts. Overall height of the tube is approximately 7 inches with a maximum diameter of 3½ in. Federal Telephone & Radio Corp., 32 Central Ave., Newark 1, N. J.



FEDERAL POWER TUBE

Transformer

This new cold cathode transformer is a 900-volt unit designed for the operation of two standard 8-ft. 20 or 25 mm fluorescent lamps with gas pressures ranging from 3 mm to 7.5 mm of mercury. It may be used with lamps operating under adverse conditions such as show cases and the like where low temperatures are encountered. Although designed for standard lamps it may also be used with custom-built lamps of comparable lengths and diameters. It embodies in its construction the Sola constant voltage principle. Failure of one lamp in no way affects the operation of the other. An outlet box has been provided with five knockouts to permit leads to be brought in from top, bottom, end or sides. Sola Electric Co., 2525 Clybourn Ave., Chicago 14, Ill.



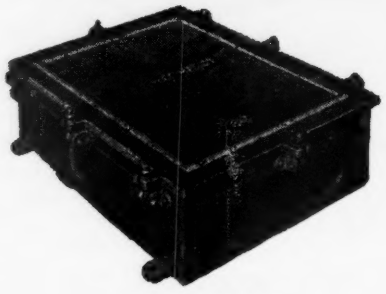
SOLA TRANSFORMER

Fluorescent Lamps

These new fluorescent lamps known as LS Types, will be supplied in smaller diameters and new standard lengths up to 96 inches. Operating without starters these lamps may also be operated in series on a single ballast at 100 or 200 milliamperes or at other currents within this range to provide high lighting levels or lower intensities for many industrial and commercial installations, including hallways, showcases, and railway cars. Life of Type LS fluorescent lamps at 200-milliampere operation is expected to be comparable to that of 40-watt standard fluorescent lamps. These lamps, equipped with single contact bases, are available in 3500 deg. white. Ballasts and accessory equipment will be available through regular trade channels as soon as wartime limitations permit. A new 13-watt miniature lamp, in white or daylight, 21-in. long and ⅝-in. in diameter has also been announced. Approximate initial lumens are 580 for the white and 490 for the daylight. This lamp is of the conventional two-prong, starter type but will require a new ballast for its operation. Sylvania Electric Products, Inc., Salem, Mass.

Junction Box

A newly designed line of cast iron junction boxes, embracing many improvements in structure and weatherproofing, has been announced. They are constructed of close-grained gray iron castings of machinable quality. Drilling and tapping is done to individual specifications. Bosses are supplied as required. The line includes boxes with flanged or unflanged recessed covers for flush or surface mounting or light wall construction, sidewalk boxes, overlapping hinged-cover boxes, and heavy duty junction or pulling boxes. O. Z. Electrical Manufacturing Co., 262 Bond St., Brooklyn 2, N. Y.



O. Z. JUNCTION BOX

Instrument

Based on a new principle, the recently developed CML Model 1200 Stroboscope increases the range through which moving objects may be examined. Rotary speeds from 600 to 600,000 rpm or vibrations from 10 to 10,000 c.p.s. can be stopped and studied. As the light source is mounted in a small probe at the end of a 5-ft. flexible cable, small objects may be easily viewed at close range. Provision is made to operate the unit from external tuning fork or crystal standards, where extreme accuracy is required. The motion of objects moving at irregular speeds may also be stopped with this model. A light intensity control switch is also provided. This enables the user to control both the intensity of the light and the duration of the pulse length. Communication Measurements Laboratory, 120-24 Greenwich St., New York, N. Y.

COMMUNICATION STROBOSCOPE

Collyer

VARNISHED CAMBRIC

THE CABLE WITH A PLUS

When you buy wire and cable, it's the *EXTRA* margin of quality that pays off in *EXTRA* service and reliability. Here at Collyer our business is founded on years of delivering this extra quality.—It's the PLUS that makes Collyer Varnished Cambric Wires and Cables leaders in the field.

Produced by modern machinery and experienced workmen, Collyer Varnished Cambric Wires and Cables have high dielectric strength and exceptionally long life even under difficult operating conditions. Let us know your requirements.

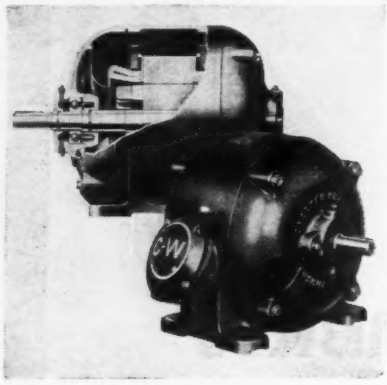
Collyer

INSULATED WIRE COMPANY

247 ROOSEVELT AVE., PAWTUCKET, R. I.

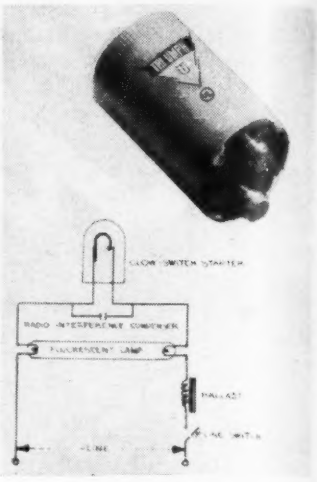
Motor

A new motor, combining the surplus capacity of the conventional open motor with protection against dripping liquid, falling metal chips and other foreign matter, has been developed. These protected type motors are rated 40°C rise full load continuous duty, with a 15 percent service factor. They are available in sizes up to and including the 284 frame. Mounting dimensions conform to the standards of the National Electrical Manufacturers Association. There are no openings in the frame or shields above the horizontal center line. Some of the features of these motors are: Alucast rotor construction; heavy cast frame construction, coils protected by vinyl acetal insulation; interchangeable front and rear shields; specially designed guides for directing cooling air over all surfaces.—Crocker-Wheeler Div., Joshua Hendy Iron Works, Ampere, N. J.



CROCKER-WHEELER MOTOR

Fluorescent Lamp Starter



BURKAW STARTER

The new improved "Tri-Umph" glow switch starters have two outside terminals, connected to each side of the lamp. When current is applied there is practically no voltage drop across the lamp. An ionization occurs in the low pressure neon or argon atmosphere tube according to type of lamp. Contacts in the tube are normally open, and are closed through the glow discharge which heats the bimetal U-element and starts preheating the cathodes. Glow discharge in the starter is eliminated when the contacts are closed and the bimetal cools and returns to its normal position, generating, with assistance of the ballast, its own voltage or inductive kick to start the fluorescent lamp. It also has enclosed condensers to prevent radio interference. —Burkaw Electric Co., 105 E. 29th St., New York 16, N. Y.

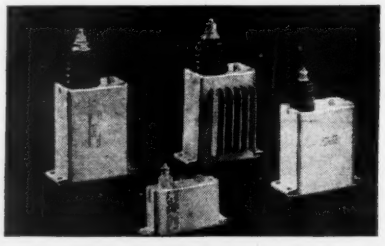
Indicating Light

A new indicating light De Luxe 659 D/E unit for 120-volt service is now available. It is of such a shallow depth that it can be used where most other units cannot. The overall depth behind the front of the panel to the extreme end of the insulation barrier is 1 inch. It is for single-hole mounting in a $1\frac{3}{8}$ in. diameter hole in panels up to $\frac{1}{4}$ in. in thickness. The exposed holding lip is of the hex nut type. The screw type lens-cap which contains the heavy walled glass lens, is removed from the front of panel and allows for easy installation and removal of lamp bulb. The molded bakelite socket is of the candelabra screw base type for use with the SN-120 volt tungsten lamp or the T4½ neon glow lamp. A $\frac{1}{4}$ in. square insulation barrier separates the two 6/23 terminal screws. The terminal screw base type for use with the S6-120 volt tungsten lamp members providing a direct-line electrical contact, without the use of solder. The H. R. Kirkland Co., Morristown, N. J.

KIRKLAND INDICATING LIGHT

High-Frequency Paper-Dielectric Capacitors

A new line of high-frequency paper-dielectric capacitors, available in ratings of 5000 to 20,000 volts d-c, 0.01 microfarad, has been announced. Developed primarily for a grid- and plate-blocking service in the electronic-oscillator circuits of high-frequency induction-heating equipments, they can also be used to advantage in other high-frequency oscillator circuits of a similar nature. The high-voltage paper-dielectric capacitors are of relatively high capacitance for high-frequency units. The internal kraft-paper and aluminum-foil assemblies, compactly arranged and thoroughly impregnated with a low-loss liquid dielectric, are hermetically sealed in rectangular metallic cases. The size of the case cover and the over-all dimensions of the capacitors is reduced by use of a single insulated terminal, provided with a threaded terminal stud. For the other terminal, a stud is provided for connection to the case cover. The units are supplied with removable footed-type brackets, which provide for a firm four-point mounting in any position. The 20,000 volt rating is available in two designs—one in a plain case and the other with cooling fins to permit a higher current-carrying capacity. General Electric Company, Schenectady 5, N. Y.



G-E CAPACITORS

POWER and FEEDER CIRCUIT CABLES PROTECTED by HAZAKROME

HAZAKROME, a thermoplastic synthetic resin, has become recognized as highly satisfactory insulation since its introduction more than five years ago.

Hazakrome contains no rubber, although it possesses many of its desirable characteristics. Its non-flammability makes it definitely superior to rubber. Its smooth surface is resistant to oil, moisture, acids and alkalies, ozone and continued exposure to the atmosphere. This makes Hazakrome a highly desirable insulation for low voltage light and power circuits up to 600 volts, and for underground cable for series lighting circuits up to 5000 volts.

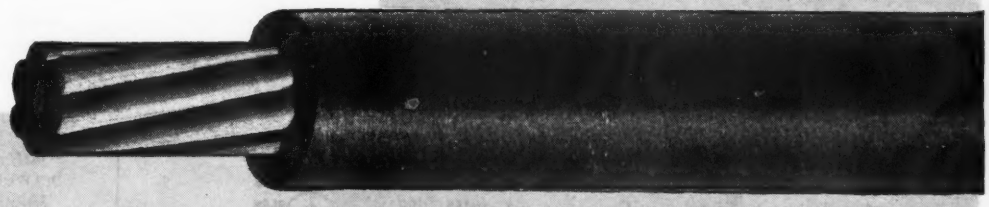
Hazakrome is ideal for installation in ducts and raceways because of its toughness and its smooth surface.

For direct burial in the ground further protection is provided by the addition of tape, and flame and moisture resistant braid. Multiple conductors, separately insulated with Hazakrome, can be cabled together and encased in a Hazakrome armor sheath. Hazakrome Underground Cable meets all the requirements of Civil Aeronautics Administration. Specification No. 538.

Types SN and SNW Building Wire

Type SN Hazakrome Building Wire has the big advantage of small diameter. No fabric covering is necessary because the smooth surface of the insulation resists all deteriorating influences.

Type SNW Hazakrome Building Wire is the moisture-resistant grade approved by Underwriters' Laboratories for wet locations in place of Lead Encased Cable as provided in Section 3035 of the National Electrical Code. Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.



HAZARD

insulated wires and cables for every electrical use

3090

PRACTICAL ARTICLES on the application, installation and maintenance of electronic apparatus in industry. Readers are invited to contribute items from their experience to this department. Articles used will be paid for.

ELECTRONICS

Installation, Maintenance and Servicing of Electronic Motor Control—IV

B. J. Dalton
Industrial Engineering Division
General Electric Co.

DEFECTIVE tubes or other obvious troubles should be given first consideration in any analysis of improper operation of electronic motor control. The armature and field rectifier and power circuits, and the magnetic and auxiliary a-c control circuits should be considered next. Methods of isolating faults in the various components were discussed in the preceding installment of this series.

Although the electronic circuits which control the armature and field rectifiers and provide most of the special functions may appear to be the most complicated part of the entire equipment, experience will show that with the exception of the tubes, trouble is least likely to occur here.

In all the following discussions it will be assumed that all tubes are satisfactory.

D-C Control Power Circuit

All control of both the armature and field rectifiers is accomplished through the d-c windings of the two saturable reactors ASX and FSX. D-C current flowing in the d-c windings of the saturable reactors will shift the thyratron rectifier grids to produce an output voltage. There will consequently be no output from the thyratron rectifier if there is no current flowing in the d-c windings.

Fig. 1 shows the circuit of the d-c control power rectifier which supplies all d-c for operating not only the saturable reactors, but also the vacuum tube circuits leading to the saturable reactors. This figure shows the approximate voltage which will be present when the rectifier is working properly.

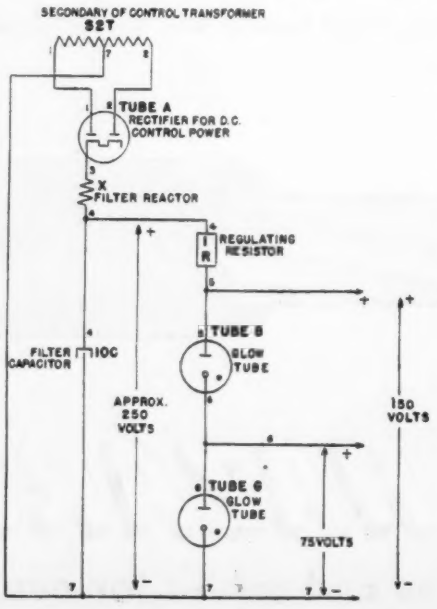


FIG. 1-D.C. CONTROL POWER CIRCUIT

Although voltmeter measurement is the most satisfactory method of checking this circuit, the two tubes (B and G) can, in a sense, be used as voltmeters. If both B and G tubes glow it is likely that the proper voltage is across lines 5, 6, and 7. A short circuit across lines 6 and 7 would prevent tube G from glowing and would overload both tubes A and B, as well as resistor 1R, filter reactor X, and transformer 2T. A short circuit across lines 5 and 6 would cause tube B to "go out", while a short across lines 5 and 7 would cause both B and G tubes to "go out". Any of these short circuits is likely to cause damage to the other tubes and components.

While it is possible that short circuits may develop in the internal panel wiring, it is likely that the ones just described might be in the outgoing panel leads. If so, they can be isolated by removing the external leads at the panel terminal board.

Resistance and Voltage Measurements

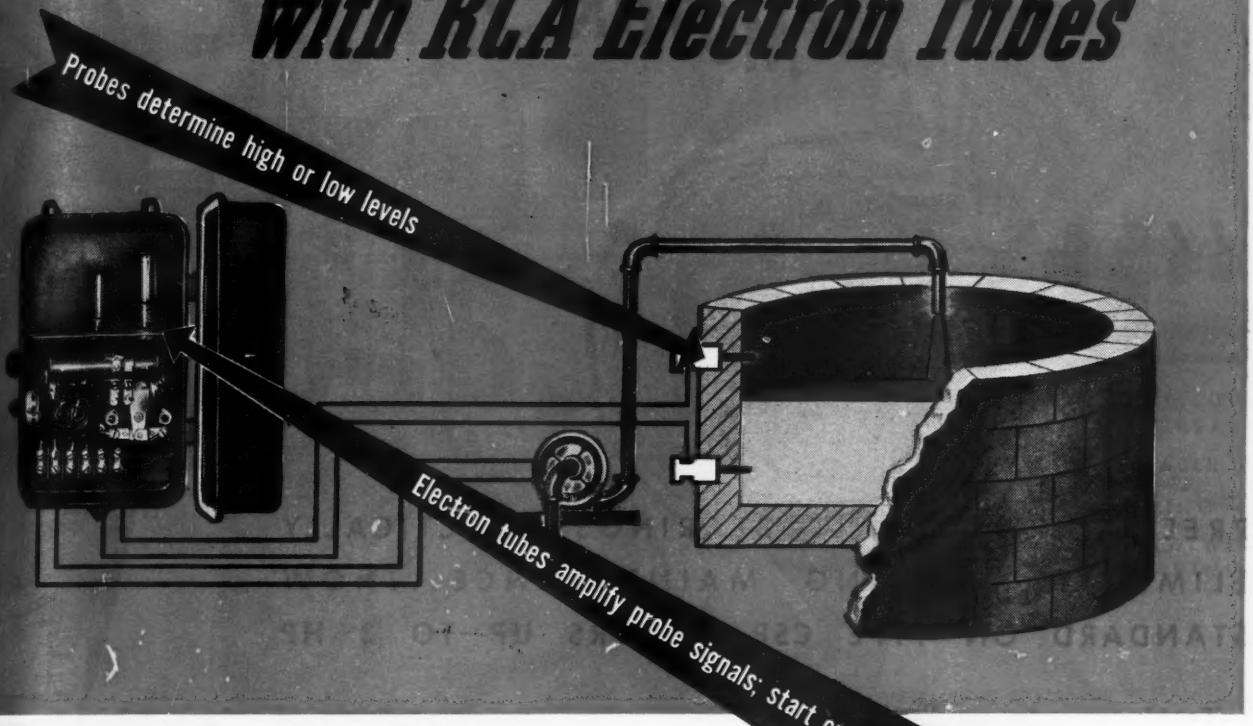
Possible internal troubles are an open resistor 1R, or reactor X; a shorted capacitor 10C or an open winding on transformer 2T. The resistance of these parts should be measured with power off.

Another approach is to measure voltages with power on. D-C measurements can be taken between point 7 (—) and points 6, 5, 4, and 3, (all +), respectively, to determine short or open circuits. If the filament of tube A is lighted but there is no voltage from 3–7, the a-c voltage 7–1 and 7-2 should be measured. Both voltages should be approximately 300 volts. An open transformer 2T would be indicated if tube A did not light or if there were no a-c voltage output between 1–2.

Field Regulating Circuit

Fig. 2 shows how the various circuits fit together to give control of the motor field voltage. The rectifier and the a-c control circuits at the top of the figure were discussed in the preceding installment. Let us assume that these circuits, as well as the d-c control circuit, just discussed, (shown at

How to Improve Level-Control with RCA Electron Tubes



Liquid or powder levels can be controlled better electronically—New method gives long, trouble-free service—Easy to install; no maintenance problem

New Electronic Equipment by Photoswitch, Inc. — Equipment developed by Photoswitch Incorporated makes possible precision level-control of all powders or liquids regardless of viscosity, conductivity, combustibility, or temperature —whether corrosive or noncorrosive.

Electronic level-control equipment is now being used in thousands of industrial plants—chemical, food-packing, dairy products, breweries, and every other industry where level-control problems exist.

Applications:

1. Initiate pump, motor, or valve-control at one or more predetermined levels; set off signals and alarms
2. Initiate various pump-programming operations
3. Control the interface between two liquids—such as water and gasoline
4. Control degree of concentration when liquids are being mixed
5. Detect boiler-feedwater contamination

How It Works — For conductive liquids, a metal probe is inserted in the system at the level to be controlled. The probe is connected through a coaxial cable to an electrical circuit. When liquid comes in contact with the probe (or in some cases breaks contact with the probe), a minute current passes through the electrical system. This is amplified by RCA Electron Tubes. The amplified current operates a relay causing the desired operations to be performed—such as operating valves or pumps.

For nonconductive liquids and for powders, a capacitance-type probe is used.

Turn to Electronics for Solution of Your Own Problems—If you are interested in electronic level-control, write to *Photoswitch Incorporated,* Cambridge 42, Mass.

Electron tubes are providing a practical solution to hundreds of diversified manufacturing problems—process-control, machine-control, heat-treating, plant-protection, and a host of others. Consult with RCA tube-application engineers for information or advice on possible applications of your own. For examples of electronics at work in our own factories, send for the free 32-page booklet, "Electrons In Action At RCA." Write to RCA, Commercial Engineering Section, Dept. 62-52S, Harrison, N. J.

THE FOUNTAIN-HEAD OF MODERN TUBE DEVELOPMENT IS RCA

BUY BONDS RCA BUY BONDS

62-6336-52

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION • CAMDEN, N. J.

ANOTHER WESTINGHOUSE MOTOR "FIRST"

"No Lubrication

PRELUBRICATED BALL BEARINGS PRACTICALLY ELIMINATE BEARING MAINTENANCE...NOW STANDARD ON TYPE CSP MOTORS UP TO 3 HP

Twenty-two years ago Westinghouse was "first" with the "Sealed-Sleeve" Bearing that eliminated oil leakage, kept out dirt, and reduced maintenance on sleeve bearing motors. Today Westinghouse offers the first self-sealed, prelubricated ball bearing that eliminates lubrication for five years. Type CSP prelubricated motors bought now will need no lubrication until 1950.

Prelubricated bearings in Westinghouse motors have been thoroughly field-tested in thousands of Westinghouse lint-free textile motors. Recently a series of bearings was chosen at random and inspected from a group of 600 motors, the first of which were installed between six and seven years ago. All were in perfect condition—even though they had been in operation 24 hours a day and had never been lubricated.

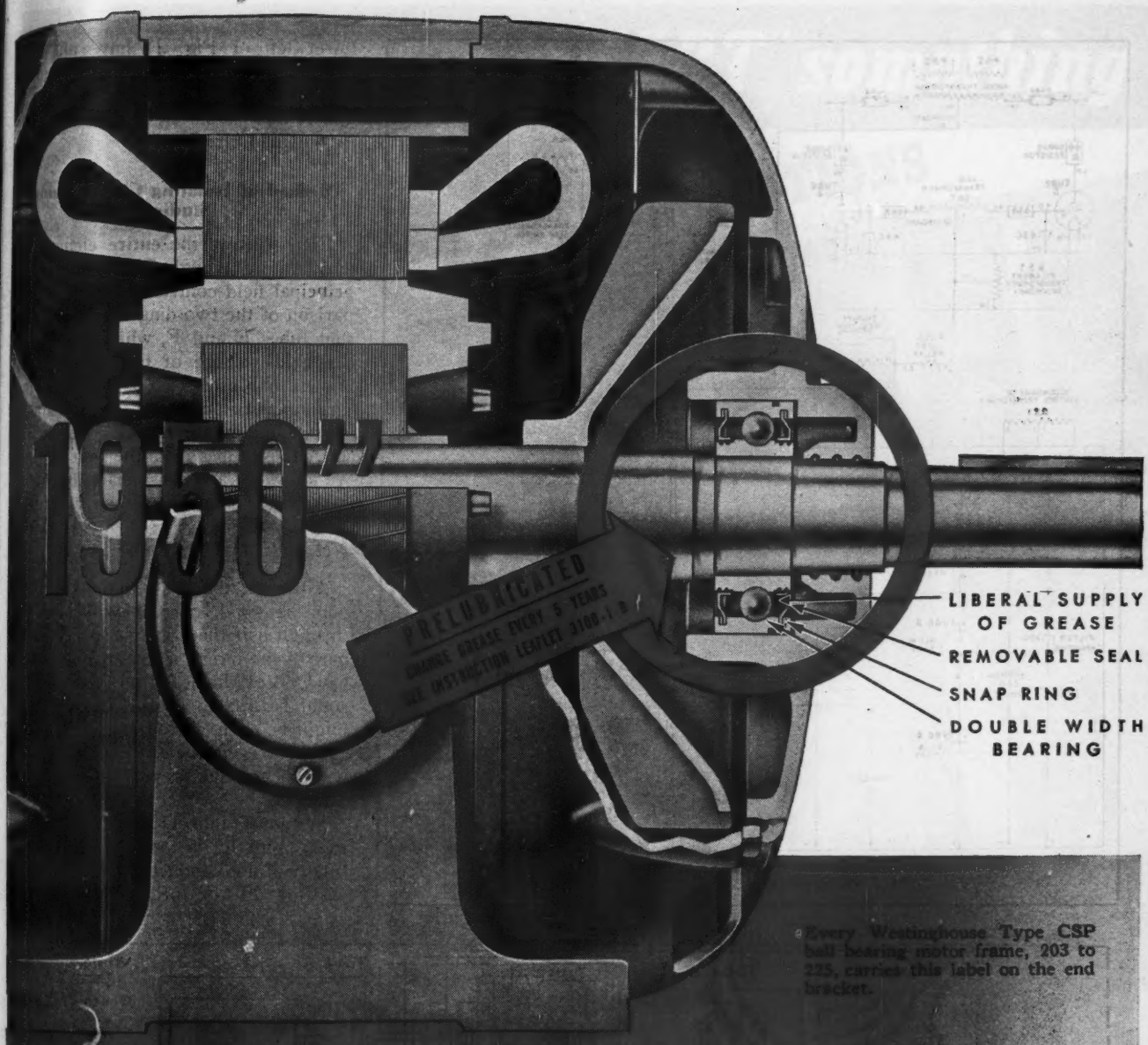
Time-tested special applications such as these have often paved the way for improvements in standard motors. Type CSP motors incorporate the fruits of wide Westinghouse motor application experience. When you buy a Westinghouse Type CSP motor, you get all the latest improvements. For complete information, write for DB 3100-CSP, Westinghouse Electric & Mfg. Co., P.O. Box 868, Pittsburgh 30, Pennsylvania. J-21318

ADVANTAGES

OF WESTINGHOUSE TYPE CSP MOTORS

- PRELUBRICATED SEALED BALL BEARINGS reduce lubrication maintenance . . . assure longer grease life.
- IMPROVED TUFFERNELL INSULATION.
- DYNAMICALLY-BALANCED ROTOR.
- DIE-CAST ROTOR with oversize fan.
- LIBERAL THROUGH-VENTILATION—air enters front, leaves at drive-end of motor.

WESTINGHOUSE



Every Westinghouse Type CSP ball bearing motor frame, 203 to 225, carries this label on the end bracket.

PRELUBRICATED SEALED BEARING CONSTRUCTION ...retains original grease packing within the stationary seal discs. Bearing chamber accommodates grease sufficient for more than five years of severe service. Held by snap rings, seal discs fit closely over inner race, forming an efficient seal. Snap rings and discs are easily removed to permit packing new grease in bearings.

Westinghouse

TYPE CSP MOTORS

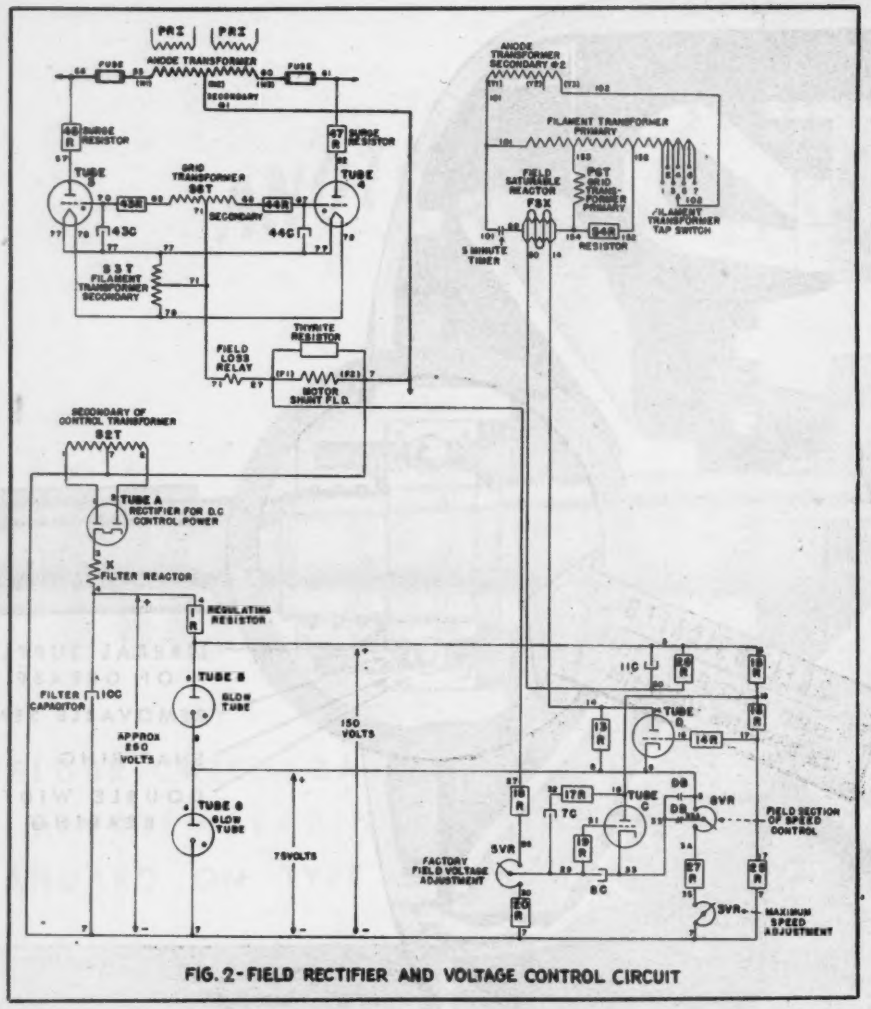


FIG. 2-FIELD RECTIFIER AND VOLTAGE CONTROL CIRCUIT

lower left of Fig. 2) have all been found satisfactory. The field regulating circuit shown at lower right is almost all that is left to cause trouble in the field circuit.

Method of Isolating Circuit Being Studied

Fig. 4 shows the entire elementary diagram. Although Fig. 2 shows the principal field control circuits, a comparison of the two diagrams will show that tubes E and F, which can effect the grid voltage of tube D, are not shown in Fig. 2. To be sure that the circuits associated with tubes E and F do not bother our thinking, let us remove these tubes from the panel. Now we know we are considering only that part of the diagram shown in Fig. 2.

NO FIELD VOLTAGE

Although the d-c winding of FSX may be good, current will not flow through it if there is an "open" in any part of the circuit between lines 5 and 6. One of the leads on resistor 28R could be broken or the resistor itself might be open. Broken leads or loose connections at the tube socket, points 6 or 14, would prevent current from flowing.

We know tube D is good, but if its grid, point 15, is too far negative the tube will not conduct. Broken leads on resistors 15R or 16R, or open resistors

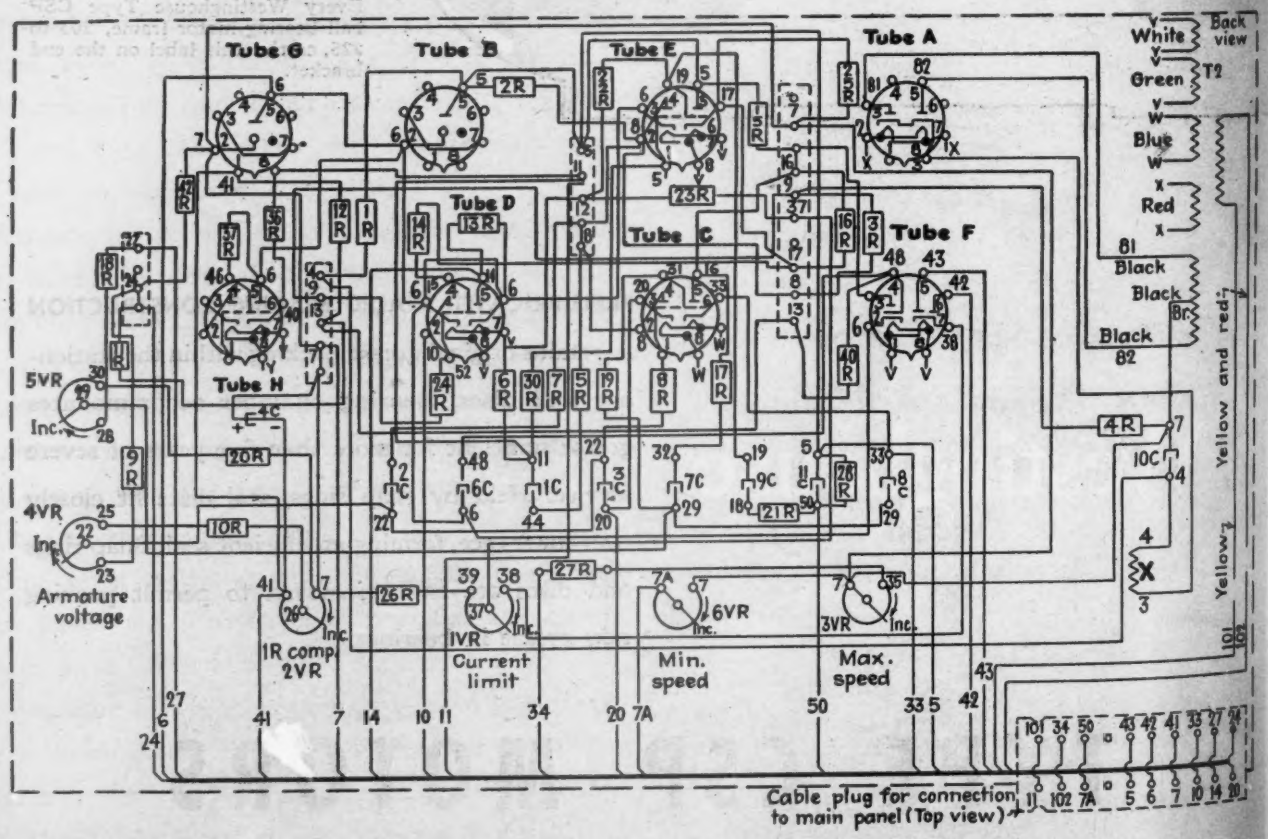


FIG. 3—WIRING DIAGRAM OF CONTROL CIRCUITS WITH COMPONENTS MOUNTED ON SUBPANEL.

IF you want to "START" something

—use "3C" TYPE D PUSH BUTTON STATIONS

3 UNIT WITH HOLD-DOWN LOCK
4 UNIT WITH PILOT LIGHTS
10 UNIT WITH PILOT LIGHT, SELECTOR SWITCH, MUSHROOM HEAD
6 UNIT, SMALL MUSHROOM HEAD
2 UNIT STATION
5 UNIT WITH SELECTOR SWITCH
1 STATION MUSHROOM HEAD
PENDANT TYPE
TYPE RN
WATER TIGHT, NEMA ICS0-43
DUST TIGHT, NEMA ICS0-28
OIL IMMERSED, for CLASS I, GROUP D, HAZARDOUS
START
STOP

● Clark Type D Push Buttons, featuring silver-to-silver, button-type, double-break contacts, bakelite insulating parts, large electrical clearances, and plenty of wiring space, provide low maintenance and long life in heavy duty operations. Push button stop is independent of contacts. 1½" and 2¼" mushroom heads are available.

Type RN — the "ROUGHNECK" — has mushroom head, cast metal enclosure with rounded shoulders sturdy enough to take rough usage.

Watertight, dust tight, and oil-immersed types can be supplied. Pendant Stations are also available.

For every heavy duty industrial push button application there's a "3C" Push Button Station available.

THE CLARK CONTROLLER CO.

1146 EAST 152nd ST., CLEVELAND 10, OHIO • OFFICES IN PRINCIPAL CITIES

would prevent tube D from carrying any current. A short circuit between points 16 and 7, or 17 and 7, would also make point 15 too far negative. Also, if tube C is conducting too much current, tube D would be off. Removing tube C from the panel will determine whether the trouble is in the circuits of tubes C or D.

Broken leads on resistors 20R or 19R, or in line 29, as well as a short circuit between 33 and 7 would cause tube C to draw too much current and would ultimately prevent motor field current from flowing.

NO CONTROL OF FIELD VOLTAGE

Let us look now at the faults that would result in full field voltage with no control. Since d-c flowing through the saturable reactor winding results in rectifier output voltage, anything that could cause d-c to flow in this winding should be suspected. A short circuit at the socket of tube D, between points 14 and 6, or 14 and 15, would give trouble. Also an open circuit in the circuit of resistor 25R, or a short circuit between points 15 or 17, and 16 or 5, would apply full field.

Tube C, which controls tube D, could have an open circuit in its plate or cathode circuit (lines 16 and 33, respectively). Also, tube C would not control if both contacts of DB were open (a dirty contact surface might prevent current from flowing); or if the upper contact were closed; or if any other part of the circuit between points 33A and 7 were open. An open circuit between points 33A and 7 might actually be traced down to a broken connection in the leads on the field section of the speed control—or to the speed control potentiometer itself. This can be determined by resistance measurement of the potentiometer circuit.

Any failure such as a short between points 29 or 31 (Tube C grid circuit), and any higher voltage point such as 6 or 27; or an open circuit in 5VR or 20R below point 29, which would allow the grid of tube C to become more positive than it should be, would also prevent control of the field voltage.

In order to simplify the field control circuit of Fig. 2, tubes E and F were omitted. Let us look now at Fig. 4 which shows the circuits of these tubes. Insofar as control of the field is concerned, a fault in the circuits of Tube E might result in full field with no control, while a fault in the circuits of tube F might result in no field, or weak field, conditions. Tubes E and F are in the current and voltage limit circuits and will be covered more completely later.

Armature Regulating Circuit

The method of breaking a circuit into its various subcircuits has been illustrated in the past examples. This method is actually automatically followed in one's mind as he traces possible troubles from one circuit to another. Let us continue through the re-

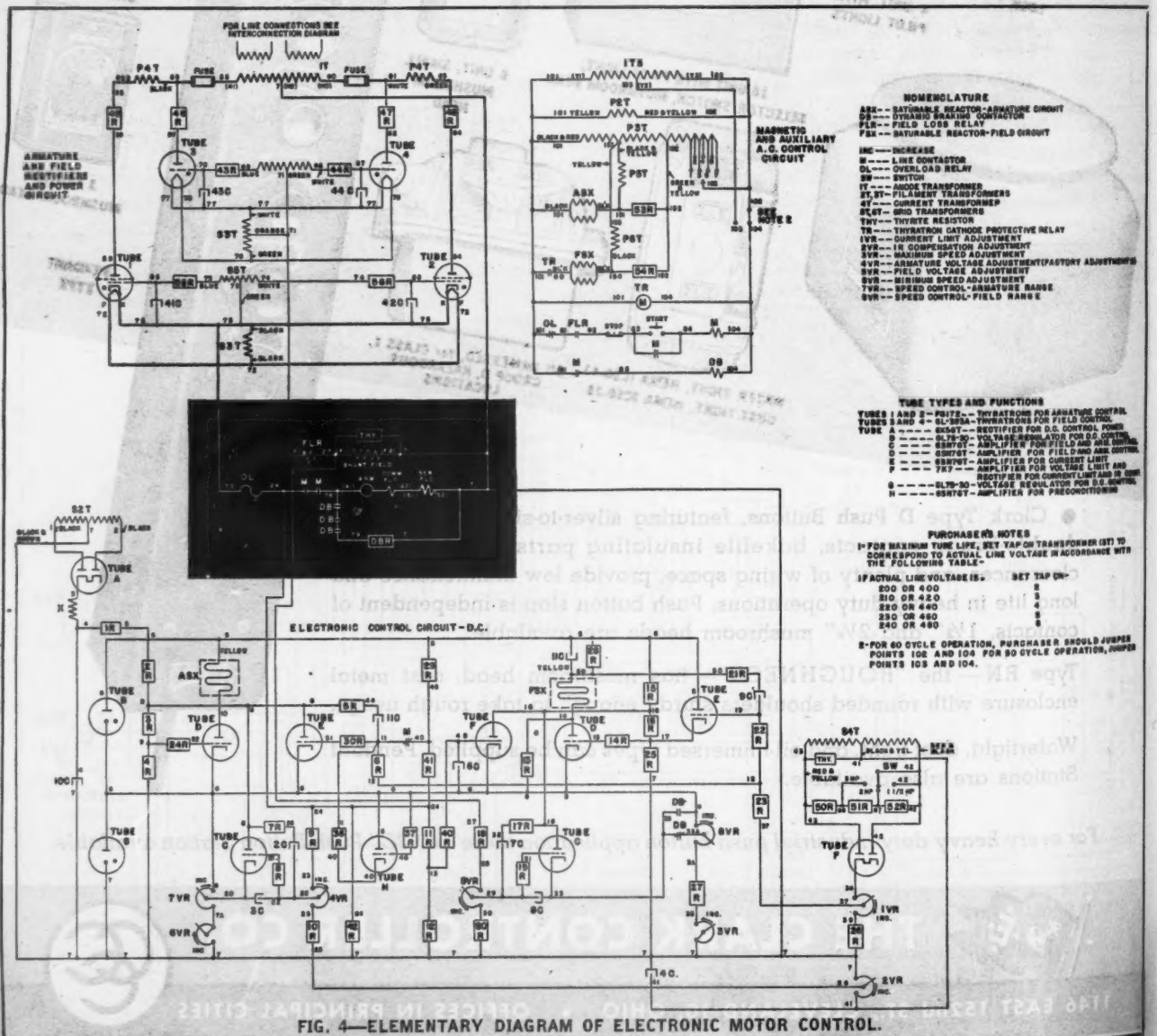

ELECTRONIC CONTROL CIRCUIT - D.C.
MAGNETIC AND AUXILIARY A.C. CONTROL CIRCUIT
ARMATURE AND FIELD RECTIFIERS AND POWER CIRCUIT
NOMENCLATURE
TUBE TYPES AND FUNCTIONS
PURCHASER'S NOTES

FIG. 4—ELEMENTARY DIAGRAM OF ELECTRONIC MOTOR CONTROL.

Improved BALLASTS
FOR FLUORESCENT LIGHTING

COLD CATHODE BALLASTS

The Jefferson Electric Ballast for cold-cathode use incorporates a transformer, two reactors and a capacitor which is enclosed in a case 2½" x 3⅛" x 9½", having a total weight of nine pounds. This Ballast lights two 40-watt tubes with a power consumption of 105 watts and operates from the ordinary 115 volt alternating current lighting system.

Because cold cathode fluorescent lighting is one of the most recent developments in the lighting field, innovations and new ideas in tubing will be introduced. As these lamp developments take place, Ballasts for their operation will be made available.

HOT CATHODE BALLASTS

In the complete line of Jefferson Electric Ballasts, capacities and types for all commercially made fluorescent lamps are included. Correct engineering, control of all steps of production in our own plant, equipment and facilities not matched anywhere—insure highest uniform quality and quiet operation, and long life.

END OR BOTTOM LEADS

Jefferson Electric Ballasts are now available in two-lamp 40-watt sizes designed to bring leads either from the ends or bottom, the latter particularly suited to mounting on narrow wiring channels. This type of Ballast reduces the number necessary to carry in stock.

All types of Jefferson Electric Ballasts are acceptable by lamp manufacturers for operation of their products as evidenced by the E. T. L. certification.

JEFFERSON ELECTRIC

JEFFERSON ELECTRIC COMPANY • BELLWOOD (SUBURB OF CHICAGO), ILLINOIS

In Canada: Canadian Jefferson Electric Co. Ltd., 384 Pape Avenue, Toronto, Ont.

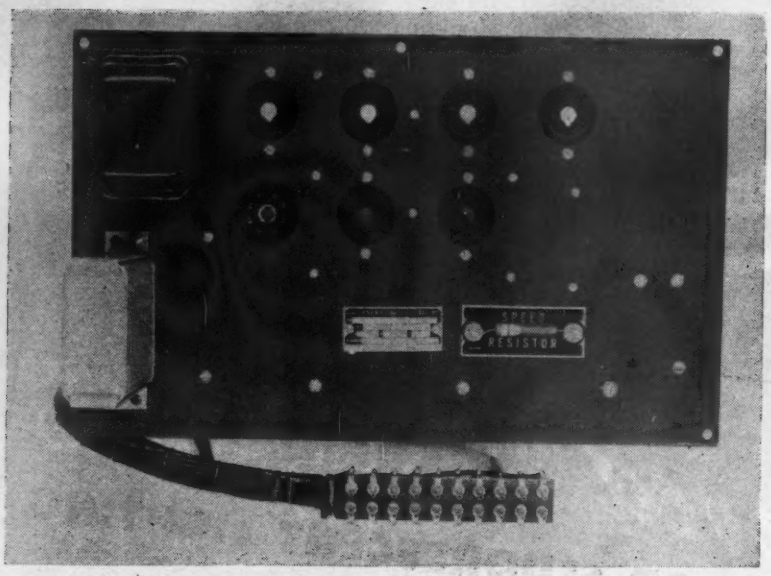


FIG. 5—Tube control panel for individual mounting in main unit of electronic motor control.

mainder of the circuit with reference only to the entire diagram of Fig. 4 and see how the simple functional circuit elements can be automatically isolated from remainder of diagram.

As was mentioned in a previous installment, tubes C and D each actually consist of two separate tube functions in one glass envelope. In this particular equipment tubes C and D, shown on the left, perform functions identical with the field control tubes C and D shown on the right.

CIRCUIT SAME AS FIELD REGULATING CIRCUIT

A careful comparison between circuits supplying ASX on the left and FSX on the right will show them to be practically identical. (Let us assume now that we are talking only about the functions of tubes C and D, and that the associated tubes are omitted.) Resistors 2R, 3R, and 4R, for example, perform the same functions in the armature circuit as resistors 15R, 16R, and 25R perform in the field circuit.

The cathode (point 20) of the left hand tube C is connected to the speed control potentiometer 7VR and minimum speed potentiometer 6VR circuit in a little different manner than the other cathode (point 33 of tube C on right) is connected to the circuit incorporating the dynamic braking contacts DB, speed control potentiometer 8VR, resistor 27R, and maximum speed potentiometer 3VR, because the field is controlled in the reverse sense of the armature. These differences, however, do not effect the basic circuit operation and should make no difference in the manner in which the two circuits are analyzed for possible troubles.

Current Limit and IR Compensation Circuit

Current transformer 4T has two primary windings, one in each of the two armature rectifier tube anode circuits. The current through these windings is transformed to a higher voltage and applied to the rectifier section of tube F, where it is rectified. An output voltage proportional to load is then applied to the two grids of tube E to control both the armature and field circuits.

CURRENT LIMIT TOO HIGH

The failure of one thyratron armature tube or a short circuited primary will cause the current transformer to saturate, and its output voltage to drop. A short circuit between any of the secondary leads will also mean lower output voltage. This means lower voltage applied to the grids of tube E, and a higher value of current limit.

A short circuit at the output of the rectifier; or between grid and cathode of tube E; or an open circuit in lines 38, 12, 11 or 51; or resistors 23R, 22R, 6R or 30R, or potentiometer 2VR will all make the current limit circuit inoperative by preventing tube E (the current limit control tube) from functioning.

CURRENT LIMIT TOO LOW

Resistors 50R, 51R, and 52R are used as calibrating resistors on the current transformer. An "open" in the circuit of these resistors will unload the transformer and for a given armature current will result in a higher voltage output with a lower current limit value. An open circuit below (in voltage) the slider or potentiometer 1VR will reduce the current flowing in the potentiometer circuit and give a low current limit.

Other possible troubles could be shorted capacitors 11C or 9C, or other short or open circuits which would cause either section of tube E to conduct too much current.

IR DROP COMPENSATION

The current limit rectifier circuit, just discussed, supplies current through potentiometer 2VR. A voltage proportional to the slider position is fed into the armature regulating circuit to increase the armature voltage as load is applied to the motor. Because both the current limit and IR drop compensation circuits are supplied by the same rectifier, a fault in the current transformer or rectifier circuit will likely effect both functions in the same manner.

Improper current limit accompanied by proper IR drop compensation indicates that the current limit rectifier is working properly, but that there is a fault somewhere in the circuits supply-

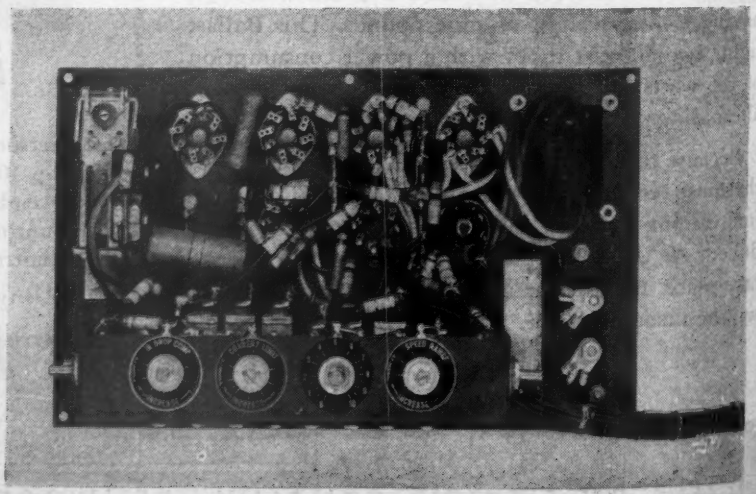


FIG. 6—Rear view of tube control panel showing chassis construction and relay for quick slow-down.

SIMPLEX-ANHYDREX UNDERGROUND CABLES

NEED NO PROTECTION FROM *Moisture*

Underground cables for electrical distribution are exposed to moisture which can cause a lot of trouble and seriously interfere with service. Metallic sheaths will keep moisture out of the cables but they often create other problems of electrolysis, corrosion, sheath losses and maintenance. A flexible, non-metallic covering, such as a rubber sheath, that will not absorb water is the ideal protection.

Simplex-ANHYDREX Underground cables are now made with synthetic insulations and sheaths that are suitable for underground service in ducts or directly in the ground. Exposure to moisture, even permanent submersion in water, has no effect upon their electrical stability. For steady, uniform underground distribution Simplex-ANHYDREX Underground cables are what you need.

Our experience with low water absorption insulations over many years is at your service whenever moisture creates a cable problem for you.

Buna S has replaced natural rubber in Simplex insulations.

Simplex Wire & Cable Co., 79 Sidney Street, Cambridge 39, Mass.

ARMY E NAVY

Simplex

WIRES and CABLES

DELTABESTON CABLES

Withstand Constant, Intense Heat

There's no tougher job for power, lighting, and control cables than service in steel mills. Operating conditions here, particularly in boiler rooms, furnaces, soaking pits, kilns, and steam tunnels require a cable with great resistance to constant, intense heat. That's why steel mill operators install Deltabeston Asbestos-insulated Power Cables. These cables have demonstrated time and again that they last and do the job well where other cables soon become unfit for service.

Deltabeston is designed not only to withstand intense heat, but high moisture, oil, grease and most corrosive vapors. Here are only a few of a complete line of Deltabeston Asbestos-insulated Cables. There's a type to fit your exacting requirements.

Deltabeston Power Cables Types AVA or AVL for general power wiring in places where constant high temperatures prevail. Insulated with felted asbestos, varnished cambric insert and asbestos braid or lead sheath over-all.

Deltabeston Boiler Room Wire Type AVA recommended for lighting and control circuits in "hot spot" installations. Insulated with felted asbestos, varnished cambric and asbestos braid.

Deltabeston Apparatus or Motor Lead Wire Type AVA for wiring all low-voltage apparatus where flexibility is required in excessive heat conditions. Insulated with felted asbestos, varnished cambric and asbestos braid—black finish.

For additional information write to Section Y 352-8, Appliance and Merchandise Dept., General Electric Co., Bridgeport, Conn. Deltabeston Asbestos-insulated Wires and Cables are distributed nationally by Graybar Electric Co., G-E Supply Corp., and other G-E Distributors.

BUY WAR BONDS AND KEEP THEM

Hear the General Electric radio programs: "The G-E All Girl Orchestra" Sunday 10 P.M. EWT, NBC. "G-E House Party" Mon. through Fri. 4:00 P.M. EWT, CBS.

GENERAL ELECTRIC

ing the grids of tube E. If, on the other hand, there is proper current limit, yet no IR compensation, the rectifier circuit must still be O.K. The trouble in this case is likely to be a shorted capacitor 4C or a short circuit between line 7 and lines 41 or 26.

Voltage Limit and "Preconditioning" Circuits

The triode section of tube F prevents too rapid application of field if the speed control potentiometer is rapidly turned down from a high speed position. Faulty operation of this circuit will be noticed either by flashing over of the motor commutator or by weakening of the motor field at low armature voltages.

If the field weakens at low armature voltage, tube F should be removed from its socket. If the field voltage then returns to normal the fault may be an open circuit in resistor 12R; or a short circuit between points 48 or 13 and a higher potential point; or a shorted grid capacitor 6C.

Flashing of the commutator might be caused by a short between points 48 or 13 and some more negative point; or by an open circuit in resistor 11R or 40R; or the associated wiring.

Tube H along with resistors 29R, 41R, 36R, 37R and contact M, form the preconditioning circuit for starting and for sudden speed changes. If either contact M or resistor 29R is open, the starting current at the first instant will be high and the motor will start with a "bump". If resistor 36R or any of the circuits of tube H is open, a "bump" will result when the speed control potentiometer is turned up rapidly.

"Anti-Hunting" Circuits

Almost all regulating type circuits require some "anti-hunting" components to provide stable motor operation. Although the operating circuits can be studied and understood without thinking about these circuits, the equipment will actually not work well without them. Wide speed fluctuations, pulsing of torque and flashing of the thyratron tubes can usually be traced to defective anti-hunting components.

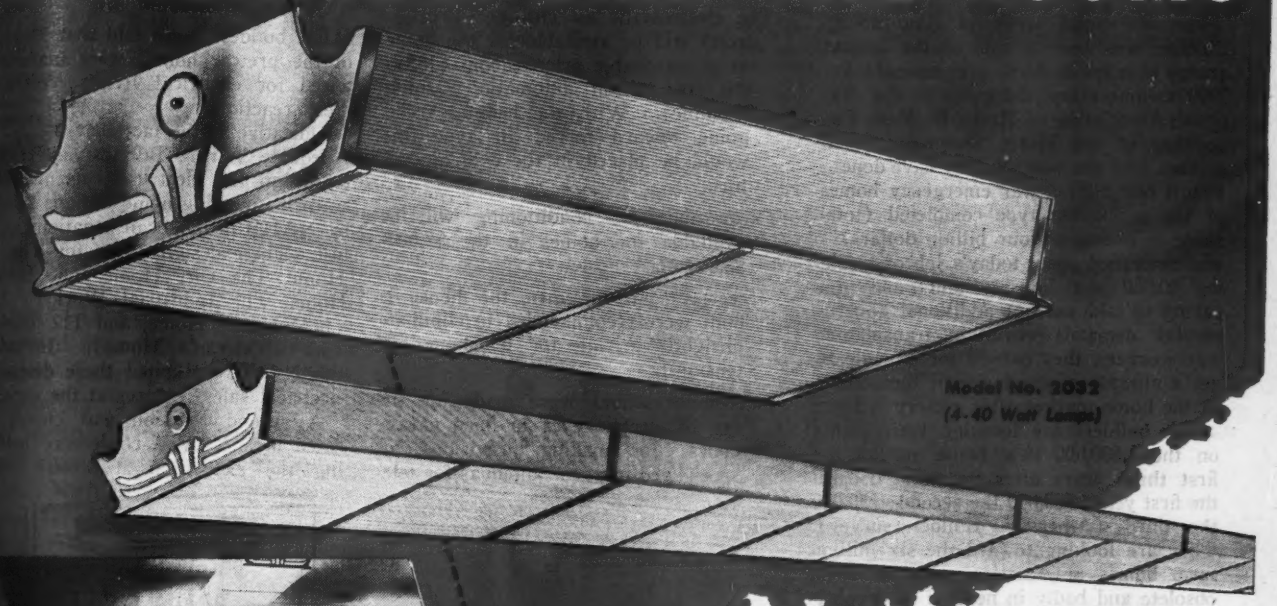
A resistor-capacitor combination often constitutes the anti-hunt circuit. Resistor 7R and capacitors 2C and 3C anti-hunt the armature circuit. The field anti-hunt circuit is a duplicate with resistor 17R and capacitors 7C and 8C. The current limit anti-hunt components are 5R and 11C, 28R and 11C, and 21R and 9C. In general, open circuits in any of these components will cause hunting under some operating conditions.

MITCHELL U.R.C. LUMINAIRE

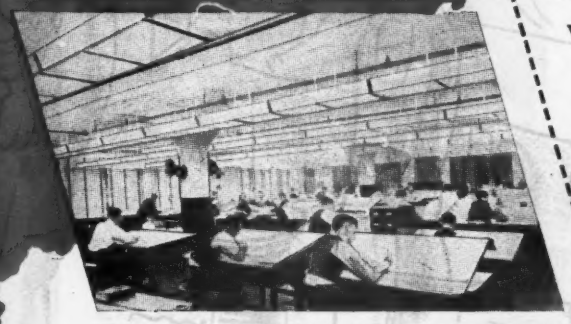
America's

FIRST CHOICE FOR

OFFICES and DRAFTING ROOMS



Mitchell U.R.C. Luminaires relieve eye strain, increase ease of work and contribute to comfort of employees.



Continuous rows of Mitchell U.R.C. Luminaires provide high illumination level without glare over entire drafting room.

HIGH INTENSITY ILLUMINATION WITH LOWEST SURFACE BRIGHTNESS

This is the *original* U.R.C. fluorescent fixture that revolutionized commercial lighting from the day it was first introduced by MITCHELL. This is the unit that brought new lighting efficiency and comfort to office work by combining maximum light output with minimum glare (surface brightness). It is adaptable for every type of interior—pendant or surface mounting, individual or continuous row. Takes less time to install than any other commercial fixture. Same low original price!

To get the original . . . *buy or specify MITCHELL U. R. C. Luminaire*

U.R.C. LUMINAIRES

Get full details from your Mitchell distributor
Or write for U. R. C. Brochure

MITCHELL MANUFACTURING CO.

2525 Clybourn Avenue • Chicago 14, Illinois

West Coast Factory & Sales Office:
1019 N. Madison Ave., Los Angeles 27, Cal.

MITCHELL FLUORESCENT

MANUFACTURERS NEWS

NAHB VIEWS THE HOME OF TOMORROW

For one solid week of Jan. 15-20, Chicago was host to one of the largest groups of home builders ever assembled—3000 members and delegates to the National Association of Home Builders Exposition at the Hotel Sherman. Well pleased with the war job they have done—almost one million war emergency homes of the permanent type completed (total value in excess of four billion dollars)—and concerned about today's job of finishing 50,000 war housing units and preparing to take care of additional governmental demands covering transplanted war workers, they paused for a while to get a glimpse of the home of tomorrow; of the home market after victory is here.

The builders are focusing their sights on the 1,600,000 new home market the first three years after the war; 350,000 the first year; 500,000 the second; 750,000 the third (American Builder survey). They are looking toward the six million farm homes in America, many of them obsolete and badly in need of modernization; on the predicted need for at least one million new farm homes.

What about the home itself? Judging from the home equipment and materials manufacturers' exhibit and the general consensus of opinion at the conference, the dream home of tomorrow will still be a dream for some time to come. The gadget infested homes envisioned by many imaginative writers will not become a reality—at least not for quite a while. The homes will be modern and functional in design with emphasis on better construction and better all-around livability.

The following interesting predictions—based on surveys and industry trends—were made at the meeting. All have a direct bearing on the amount of electrical work that will be going into the postwar home.

Of prospective home builders surveyed, 69.5 percent want separate dining rooms; more than 90 percent want automatic heating systems—requiring thermostatic control, either an oil burner or automatic stoker; 12.2 percent of one group surveyed want air conditioning.

At a panel discussion on new materials and equipment the following features of the modern home were revealed:

Compartmentalized bath rooms with shadowless, built-in medicine cabinet lighting and a ceiling outlet for built-in sun lamp.

More artificial and natural light in the kitchen with fluorescent units dominating the lighting scheme; automatic cycle washing machines requiring a separate circuit; electric dishwashers; a greater need for kitchen ventilation due to smaller sized home and better insulating construction of walls.

The electrostatic air cleaner (Precipitron) will be available for the home at a reasonable price (about $185—the cost of an automatic washing machine). With the heating trend going toward forced air type this would be placed in the cold air return.

Year-round air conditioning will be available for homes in the $7,000-$8,000 class.

Raceways put in when the house is built were recommended to eliminate unsightly wiring for telephone extensions.

Recommendations were made for the use of electric eyes to open garage doors; for making provisions for specialized televisor antennas for television sets. The possibility of using magnetic wire sound recorders in the home and in conjunction with telephones was mentioned.

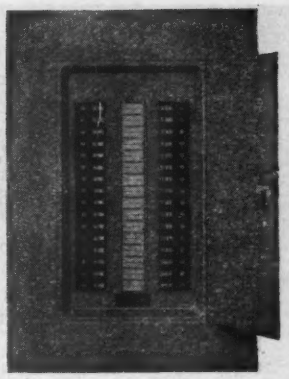
The builders were told that 95 percent of the prewar homes were inadequately wired for electrical living. What was their reaction?

Indicative is the fact that the National Adequate Wiring Bureau was permitted to design the electrical systems for the six prize winning home designs submitted by NAHB members in a nationwide contest. These designs were for The Farm Home, The City Home, The Suburban Home, The Industrial Worker's Home, The Summer Home, and The Home for Two (Veteran's Home). In addition the NAWB exhibited these designs and electrical sales features at the exposition.

A second reaction was clearly indicated in a NAWB conference held during the exposition at which some 30

"I thought I'd save you some money by running the wiring through the plumbing instead of the conduits, Mr. Jason."

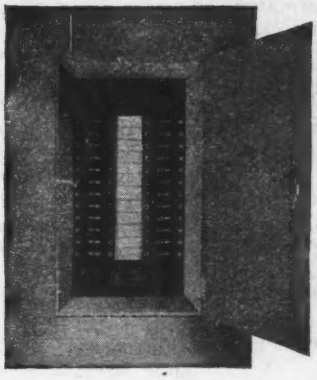
PANELBOARDS for Perfect Performance



Ⓕ A C THERMAG circuit breaker panelboard. 4 to 42 branches. Capacities 15 to 50 amperes, 120 volts AC for 3 wire single phase or 4 wire three phase mains. Standard or narrow column cabinets in surface or flush mountings.

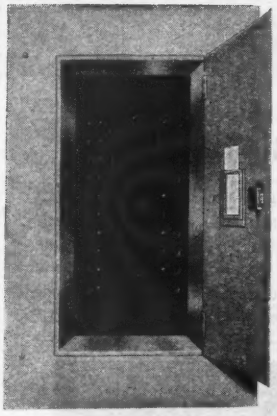
The selection of panelboards for light and power control is more important today than ever before. Additional electrical equipment in offices, factories, and commercial buildings emphasizes the need for adequate facilities in capacity, safety and service.

Ⓕ NAC1B Panelboards, with Thermag (Thermal-Magnetic) circuit breakers prevent interruption of service on momentary overload, but provide fast automatic disconnect on short circuit or sustained overload. Nothing to replace when service is broken.



Ⓕ DUBLBRAK circuit breaker panelboard. 4 to 42 branches. Capacities 15 to 50 amperes, 125 volts AC or DC, 2, 3, or 4 wire mains. Standard or narrow column cabinets in surface or flush mountings.

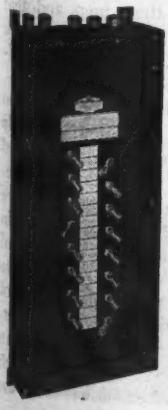
Ⓕ NA1B Panelboards, with Dublbrak circuit breakers have the finest features of thermal trip plus double make and break connections. For speed and convenience in locating trouble, a bright red button hops up when circuits are automatically disconnected.



Ⓕ Leader Type LNT1P panelboard. 4 to 42 branches. Capacities 30 amperes or less, for 3 wire AC or DC and 4 wire three phase mains. Cabinets for surface or flush mountings.

The Ⓕ Leader Type LNT1P Panelboard is made of brown bakelite moulded sections with four heavy duty, single pole tumbler switches and plug fuse connections. A favorite for many years for low original cost and trouble-free operation.

Explosive dust particles can't penetrate the Ⓕ Dust-tight panelboard. Lighting and power control in dust laden atmospheres is assured positive protection by circuit breakers sealed in a gasketed steel cabinet with external operating levers.



Ⓕ DUST-TIGHT panelboard. 4 to 42 branches. Equipped with THERMAG or DUBLBRAK circuit breakers for lighting and appliance circuits. Standard and narrow columh cabinets. Also Power panels: 15 to 600 amperes, 250 volts AC or DC and 600 volts AC.

The nearest Ⓕ representative has a wealth of information on panelboards. He will be glad to assist you. Write for his name and address.

Frank Adam

ELECTRIC COMPANY

St. Louis 3, Mo.

Makers of Busduct • Panelboards • Switchboards • Service Equipment

utility and electric league representatives gathered to discuss this subject. Typical comments at this session were:

Atlanta—Builders there look on adequate wiring as a necessity; consider it only one of the many features that go into building a home; believe it is the job of utilities, architects and electrical industry to sell the customer the advantages of adequate wiring.

Milwaukee—Wartime requirement of "electrical service certificates" has brought the builder and utility closer together; can discuss adequate wiring on a mutual basis; we must sell circuits—everyone wants enough outlets but does not know what the wiring should be.

Chicago—We can't sell just outlets—must sell *use of electricity*, then outlets and wiring to accommodate that use.

Philadelphia — Have been working closely with builders; now getting close to bankers and FHA (now willing to go along with 54 outlets in a 6-room house); recommending not more than 10 outlets per circuit; feel that builders will spend about $24 more per home to get adequate wiring.

Ohio—Home Builders' Council including bankers, builders, contractors, plumbers, school system, city planning departments and all phases of the construction industry are being sponsored by the Ohio Public Service Company. Home Planners Institutes are set up in conjunction with the council.

Toledo—Utility is going direct to the Union to teach electricians advantages of adequate wiring—working on the theory that a wireman, believing he is doing a constructive job, will sell better wiring.

Buffalo—Home Planners Institute program (sponsored by builders association, financial institutions, utility, department stores, etc.) covers adequate wiring and electrical living.

Detroit—Small electrical contractors will adhere to adequate wiring standard but is bucking against speculative builder who wants a lump sum price on an entire development, seeking to cut a few dollars from each unit.

These few examples indicate the trend to an increased cooperation between builders, the electrical industry and financial institutions to produce a better home for better living, including that oft forgotten servant—electrical adequacy. What about NAWB's plans?

The National Adequate Wiring Bureau has a five-point plan in the making. It includes:

1. A new package to sell the adequate wiring certification plan on the automatic features of the home.
2. Intensification of consumer education.
3. Intensification of educational contacts.
4. Expansion of field work—three full time field representatives after the war.
5. Close cooperation with the technical committee on the development of the Handbook of Interior Wiring Design.

The bevy of opinions expressed at this session boil down to this simple fact: The directors and members of the National Home Builders Association are conscious of the need to put adequate wiring in the homes but the electrical industry has the big job of "merchandising wiring"; selling the architect and consumer on the need of adequacy to obtain the automatic features of the home of tomorrow; selling the individual builder the idea that adequate wiring is not an "extra", but an integral part of the modern home. The more the consumer knows about the need for adequacy to attain the automatic features he or she wants, the more he or she is going to demand of the builder and be willing to pay for.

ENTHUSIASTIC NISA GROUP MEETS

A joint meeting of nearly 100 members of the New England and New York chapters of the National Industrial Service Association met on January 26, in New York City, to discuss and share experience and know-how gained over the past year. The entire group participated with great enthusiasm in a special forum, "New Ideas —How To Do the Job Better and Quicker." National President J. Arthur Turner of Tampa, Florida, conducted the forum by going right down the line calling on each individual to cite one "kink" used in his shop. Everyone greatly benefitted; unanimous note-taking was tangible evidence of this.

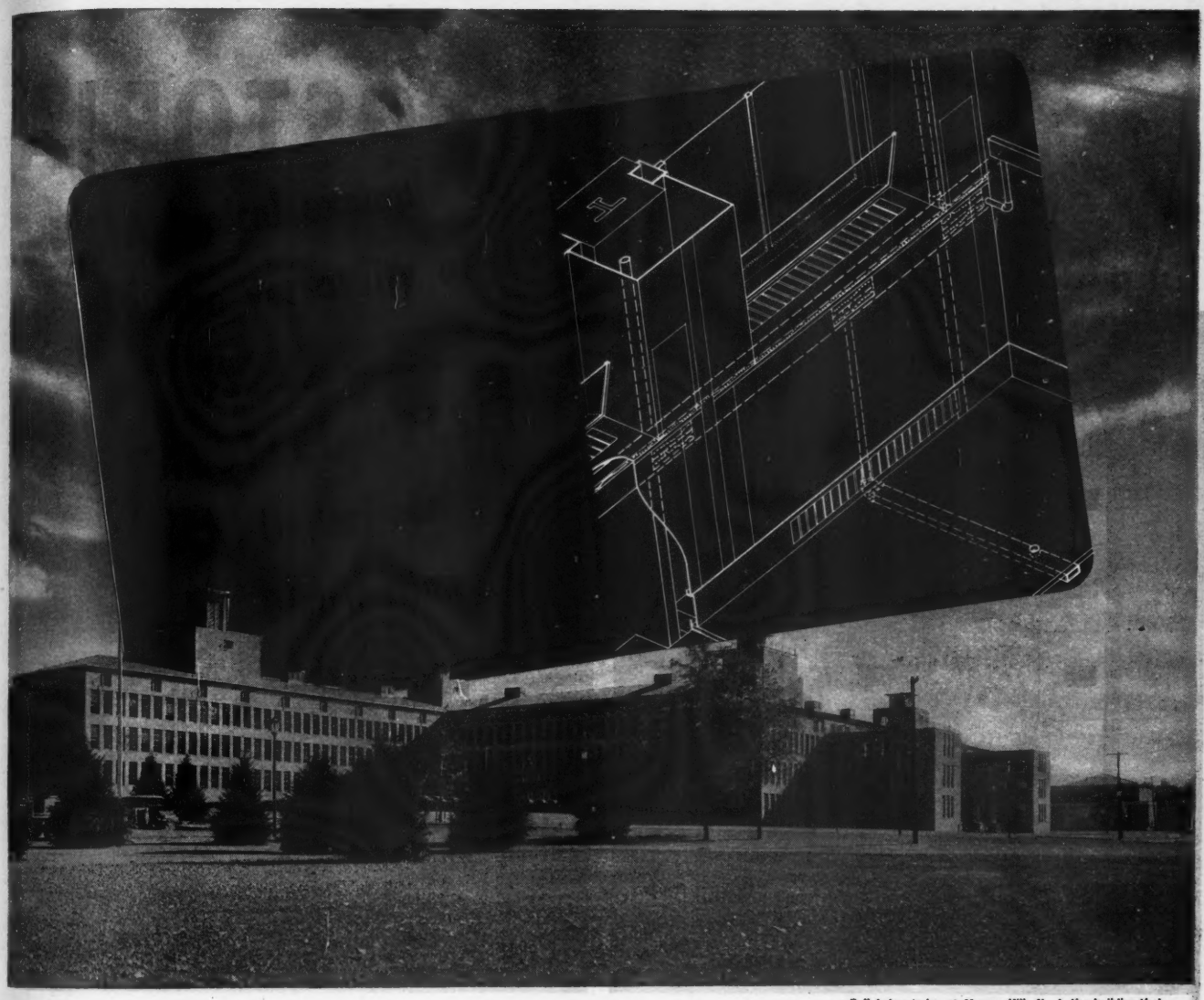
Frank Willey of Cincinnati pointed out the critical necessity of better methods and better equipment. In his evening address on Time Schedules, he said that from questionnaires sent out to a member list, every standard time schedule that had been set up had been beaten by one or more shops. Willey's contention was that if some shops can beat the schedules, they all can; and only better methods and equipment will do it. He recommended that every member plow back a reasonable percentage of the profits into better equipment which is now available. This is absolutely essential, he said, if we are to meet the postwar problems of competition, labor and government. Our shops must be modernized now when we have a few extra dollars, not only to reduce time schedules, as a solution to the present manpower situation, but also to reduce cost in meeting our postwar problems. Business and accounting methods must also be modernized.

William J. Wheeler of New York did a very able job of presiding as program chairman. The afternoon session was begun with a review of Rebuilding Standards presented by Leon Belyea and H. Q. Griffith of Jersey City. It was pointed out that the purpose of the Standards was to establish a minimum yardstick of value and gain customer confidence in NISA rebuilt motors. No serious objections to the idea were made and there remained only the details to be dealt with. An appeal was made to all members for constructive criticism and discussion before the final specifications are drawn up.

Miss Tracy, of A. S. Tracy Company, Concord, New Hampshire, addressed the afternoon group on the ability of women to do motor shop jobs. Most women workers, she said, can perform any task in the shop with proper equipment for handling heavy work. Miss Tracy was also of the opinion that only the exception (among women) like variety in their work; most like routine and learn fast. She claimed that women can wind small motors much faster than men and that they have a knack for detailed paper work such as job tagging, checking, and following jobs through the shop.

Frank Willey, in his talk on Uniform Job Classifications, appealed for help from those who have a set. He pointed out that the three elementary requirements for setting up classifications were that the worker must first do a certain amount of work, in a given time, and of a specified quality. Additional factors to be considered were the requirements of the job and the ability of the worker. Basically, the average repair shop can be broken down into six operations which must be further broken down into the

TOPNOTCH ELECTRICAL SPECIALISTS at recent meeting of Electrical Maintenance Engineers of Chicago are (L to R) guest speaker W. R. Hough, product division engineer, Reliance Electric and Engineering Co., Cleveland; A. A. Gray, secretary-manager, Electric Association of Chicago; John C. Howard, electrical engineer, Standard Oil Co. (Indiana); and James H. Miller, E.M.E., president and electrical superintendent of the Wisconsin Steel Co., Chicago.



• Bell Laboratories at Murray Hill, N. J., the building that was designed and built to last for 99 years.

Architects and Engineers
VOORHEES, WALKER, FOLEY & SMITH, New York City

Electrical Contractors
HATZEL & BUEHLER, INC., New York City

Underfloor Distribution System and "Dualcote" Rigid Steel Conduit distributed through GRAYBAR ELECTRIC CO., INC., New York City

• Above drawing shows the three-fold system of electrical wiring distribution, described in text at left.

In the Bell Laboratories' building at Murray Hill, N. J., a unique system of electric wire distribution was devised, requiring a hook-up of three different types of conduits. See drawing at right.

The Walker "Alsteel Preset" System was used for underfloor distribution. Ducts were provided at six-foot intervals, with terminal outlets inside the wall. Walker "Dualcote" Rigid Steel Conduit carried the cables to a specially designed trough which extends along the wall. The lower channel of this trough carries the high tension wires for laboratory use; while the top of the raceway carries the telephone wires. Openings at the center of each window sill provide connections with each series of wires.

This is but one of many important buildings where the Walker "Alsteel Preset" Underfloor Distribution System has been specified. It is designed to meet all present and future "change-over" and rearrangement needs encountered in distribution of light, power, telephone and signal wires. It is adaptable for flooring of all commonly used materials. And it is economical.

Ask your distributor about prices and deliveries. For further particulars, write to WALKER BROS., Conshohocken, Pa.

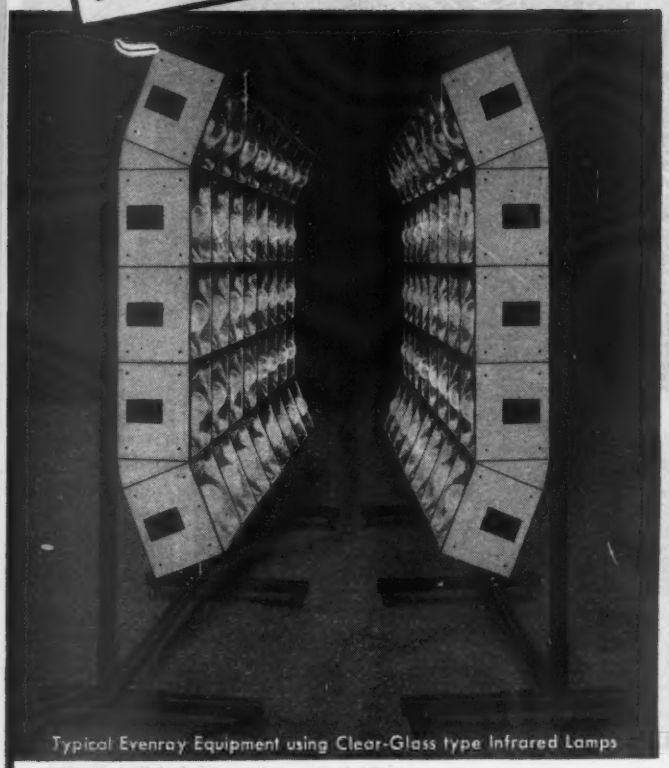
WIRE WITH WALKER

MAKERS OF

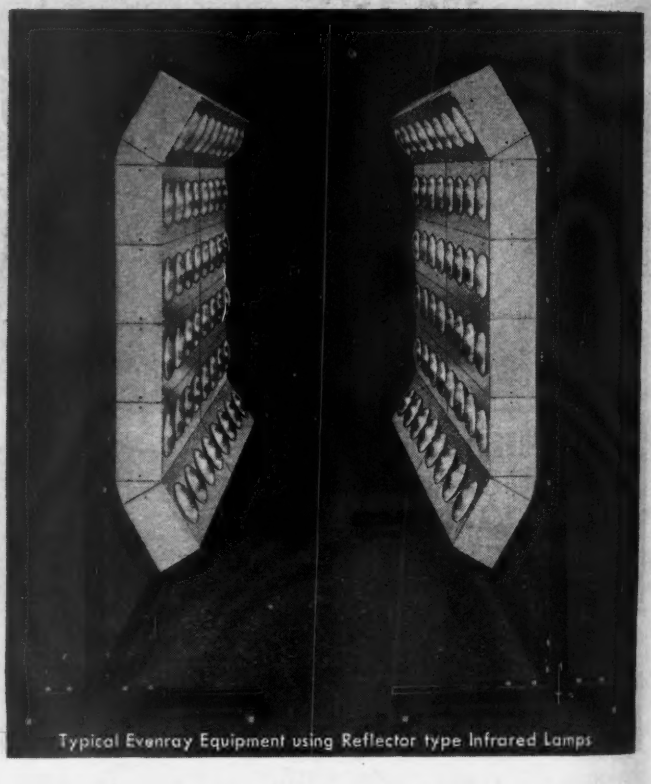
Rubber-covered, Synthetic and Leaded Wires and Cables • "Walkerflex" Non-metallic Sheathed Cables • Service Entrance Cables • Automotive Wires and Cables • Shipboard Cables—Leaded, Non-leaded: Synthetic or Varnished Cambric Insulation • Electric Metallic Tubing • "Dualcote" Rigid Steel Conduit • "Preset-Insert" Underfloor Distribution Systems.

*Highest Efficiency in the Utilization of
INFRARED
RADIANT ENERGY

The FOSTORIA
For BAKING–DRYING–



Typical Evenray Equipment using Clear-Glass type Infrared Lamps



Typical Evenray Equipment using Reflector type Infrared Lamps

INDUSTRIAL BENEFITS
OF OVER 3,000 FOSTORIA INSTALLATIONS

Saves Time The speed with which heat is transferred by the Evenray System, reduces processing time in many instances from hours to minutes.

Saves Floor Space The Evenray System provides more production per square foot of floor space.

Reduces Rejects The Evenray System processes all pieces under identical conditions with positive control.

Instant Production The Evenray System may be turned on and off as needed. Operation starts and stops instantly.

No Stand-by Loss The Evenray System requires no warm-up waiting period. There are no production delays and loss of manpower time.

Visible Operation The Evenray System permits continuous inspection of materials being processed.

Greater Flexibility A variety of materials may be processed with the same Evenray System equipment. The Infrared sources may be utilized in group combinations as required.

Economical Operation The highly efficient utilization of power gives lower energy cost per piece processed.

Worker Comfort The Evenray System affords better working conditions. No excessive warmth around the equipment. Easy ventilation of any processing odors. Fine appearance and clean operation. Safety and comfort for workers.

EVENRAY SYSTEM
fostoria
FOR BAKING • DRYING • PREHEATING • DEHYDRATING

Trade Mark
Reg. U. S Pat. Off.

FOSTORIA
Specialists in

Study of problem and pretesting for solution

Calculation of installation required

Evenray SYSTEM*

DEHYDRATING – PREHEATING

New in industrial applications only a few years ago, Infrared Radiant Energy is now utilized by thousands of plants to speed and improve production. The rapid employment of this modern technique of heat application is due in large part to the efficient equipment development and progressive research in a wide scope of applications by Fostoria.

Two factors are vital to the successful utilization of Infrared Radiant Energy—

Properly designed equipment to house the Infrared sources so that the energy is collected and distributed most efficiently. Experienced technical analysis of the application to determine the proper utilization of equipment and accurately forecast production results.

The Fostoria Evenray System provides equipment for the accommodation of energy sources in *either* clear-glass types or reflector types as is determined best for the specific application.

Reflecting surfaces of the equipment are gold plated — the most efficient reflecting medium for Infrared Radiant Energy. Housing units, which provide wide flexibility of assembly into any tunnel contour and size required, give closed construction to shield the material in process from cold drafts and dust. Source sockets are protected from heat rays and all wiring is enclosed in channels conforming to Underwriter's Laboratories specifications. These and other vital features assure the maximum of operating efficiency, easy adaption to production lines, and low maintenance cost.

Fostoria Industrial Service provides the experience of over 3,000 installations and the comprehensive technical facilities to analyze and pre-test the specific advantages of Infrared Radiant Energy for any industrial application. Your baking, drying, dehydrating or preheating problem in the hands of a Fostoria Specialist will receive expert attention and the "know-how" recommendation for sound engineering solution.

REQUEST THIS FREE BOOKLET, TODAY

Write, today, for this factual information on Infrared Radiant Energy and its economical utilization for faster and better production with the Evenray System.

Case history information applicable to your operations will be included if you send us general facts about your baking, drying, dehydrating or preheating problem.

SERVICE CENTERS
Located in Major Industrial Centers

ATLANTA
140 MARIETTA ST., N. W.
MAIN 2757

BOSTON
620 COMMONWEALTH AVE.
COMMONWEALTH 0333

BUFFALO
404 NORTH OAK ST.
LAFAYETTE 8135

CHATTANOOGA
1021 CHESTNUT ST.
PHONE 6-6194

CHICAGO
747 W. JACKSON BLVD.
RANDOLPH 6962

CLEVELAND
4500 EUCLID AVE.
ENDICOTT 6622

DAYTON
334 WAYNE ST.
FULTON 3594

DETROIT
12171 GRAND RIVER AVE.
HOGARTH 1850

INDIANAPOLIS
548 MASSACHUSETTS AVE.
RILEY 2934

LOS ANGELES
1206 MAPLE AVE.
PROSPECT 7761

MILWAUKEE
104 EAST MASON ST.
DALY 2949

MINNEAPOLIS
2 FOSHAY TOWER
ATLANTIC 7363

NEW HAVEN
(HAMDEN, CONN.)
1240 WHITNEY AVE.
PHONE 2-5985

NEW YORK
92 WARREN ST.
WORTH 2-3352

OMAHA
1102 FARNAM ST.
ATLANTIC 5540

PHILADELPHIA
(BALA-CYNWD, PA.)
349 MONTGOMERY AVE.
GREENWOOD 4477

PITTSBURGH
5339 PENN AVE.
HIGHLAND 9900

ST. LOUIS
1706 OLIVE ST.
CENTRAL 0153

SAN FRANCISCO
419-425 TENTH ST.
HEMLOCK 7611

SEATTLE
90 DEARBORN ST.
MAIN 0919

CANADA
NORTHERN ELECTRIC CO., LTD.
MONTREAL TORONTO

INDUSTRIAL SERVICE
the Application of Infrared Radiant Energy

Supervision of Installation

After-installation service

FACTORY AND GENERAL OFFICES
FOSTORIA, OHIO

Independently Affiliated Manufacturers:

Southern Industries, Inc. Atlanta, Ga. — *Newmac Company San Francisco, Calif.* — *Amalgamated Elec. Corp. Ltd. Toronto, Canada*

many individual tasks which make up each operation. The size of the shop, Willey said, of course determines the variety of jobs and number of units, but nevertheless in setting up job classifications, the overall repair operation should be broken down into as many units as possible which can be later combined to meet the requirements in the shop.

The after-dinner session was launched with a welcoming address by Henry A. Schreck, President of the New York Metropolitan Chapter, followed by introductions by Honorary Chairman W. J. (Bill) Wheeler.

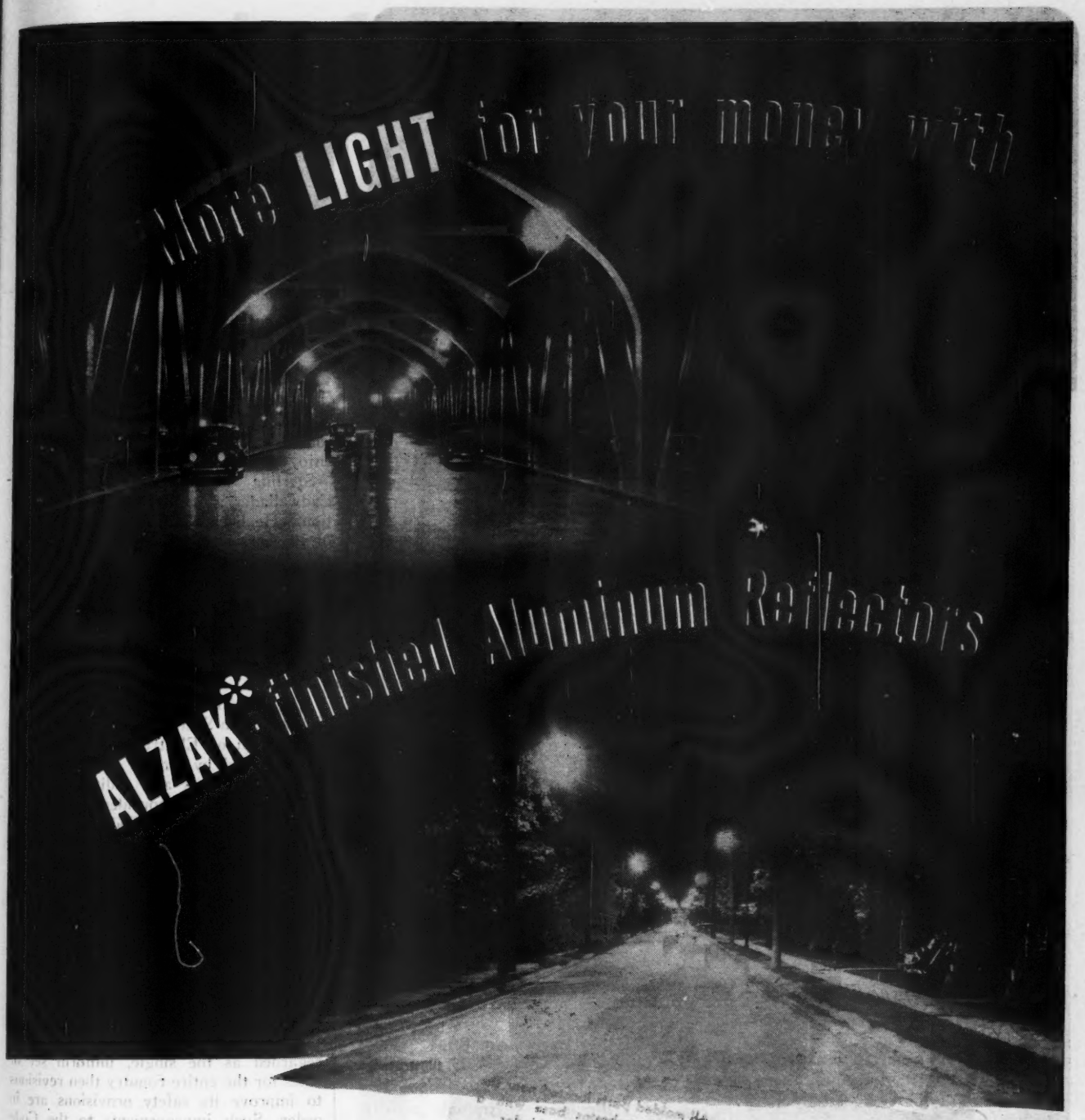
J. Arthur Turner, in his evening address, called for renewed efforts in the drive for more NISA members. He also recommended that members sell quality for the price rather than inferior work and materials for "cut-rate" operation through quantity margins. He claimed room for everyone in the industry.

Following a report of the New England Chapter by B. L. Whittemore of Framingham, Massachusetts, a "Stump the Expert" session was held during which questions from the group were solicited on problems of any nature related to motor shop operation—labor, management, government orders, "kinks", etc. Pandemonium reigned on several occasions with Arthur Turner standing between rapid fire argument on both sides when someone lost a field somewhere with two d-c generators jockeying for the rail position. The experts were Paul Keating of Boston, B. L. Whittemore of Framingham, Frank W. Willey of Cincinnati, J. Arthur Turner of Tampa, and Leon Belyea of Jersey City.

Louis D. Kennedy, Executive Secretary of the New York Metropolitan Chapter closed the meeting with a talk on Management. He said we must first meet the near-future problems of priorities, material and manpower and getting out motors to turn the wheels of our war industry; but secondly, we must do some serious thinking and actual planning of the post-war future. Sound business ethics to both customer and competitor is extremely important. Intelligent management will broaden its business ramifications to survive fluctuation of any of its elements. The efforts of all are necessary to solve both individual problems and broad industry problems. He closed the meeting with an appropriate quotation, "Cooperation is not a sentiment, but an economic necessity."

CADWALLADER RETIRES

C. C. Cadwallader retired January 1st as secretary-manager of the Detroit Electrical Contractors Association (Detroit Chapter NECA). One of the grand old men of the electrical contracting fraternity, Mr. Cadwallader handled the managership of the Detroit group for over 20 years. Before identifying himself with association work, he was connected with a Local IBEW Union; then took a turn at contracting. Mr. Cadwallader plans



Maximum efficiency for your lighting system, long life and low annual costs—you gain these benefits by specifying Alzak-finished Aluminum light reflectors.

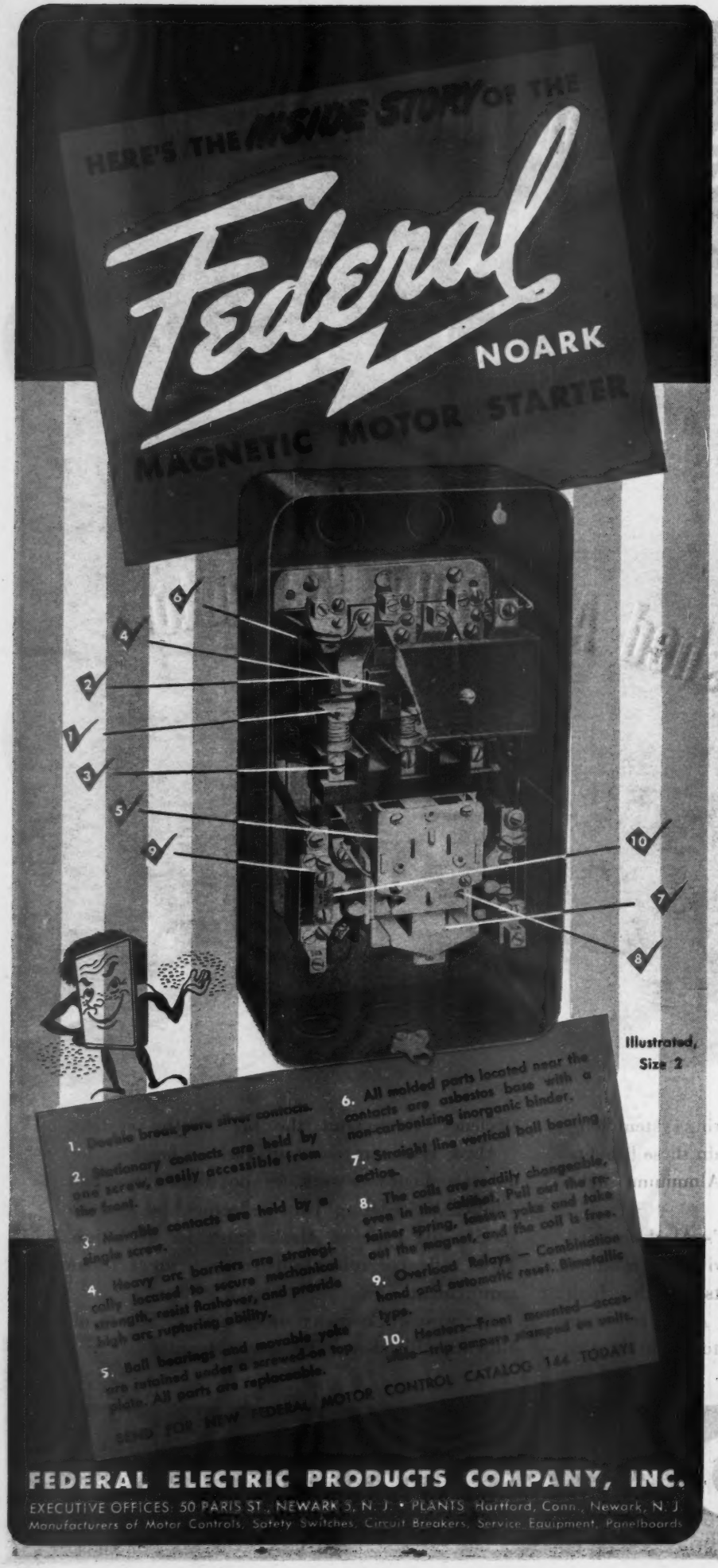
The high reflectivity of Alcoa's Alzak-finished lighting sheet, in combination with the reflector manufacturers' designs, accounts for this high efficiency. The ease with which Alzak reflectors can be kept clean enables you to maintain this efficiency throughout the life of the system.

Alzak reflectors come in various finishes; for indoor and outdoor work, for spot illumination and diffuse. In ordering your reflectors, be sure to specify the type of Alzak finish for each job. Your reflector manufacturer can meet those requirements.

ALUMINUM COMPANY OF AMERICA, 1946 Gulf Building, Pittsburgh 19, Pennsylvania.

*Registered trademark

ALCOA ALUMINUM


HERE'S THE INSIDE STORY OF THE
Federal
NOARK
MAGNETIC MOTOR STARTER
Illustrated, Size 2
1. Double break pure silver contacts.
2. Stationary contacts are held by one screw, easily accessible from the front.
3. Movable contacts are held by a single screw.
4. Heavy arc barriers are strategically located to secure mechanical strength, resist flashover, and provide high arc rupturing ability.
5. Ball bearings and movable yoke are retained under a screwed-on top plate. All parts are replaceable.
6. All molded parts located near the contacts are asbestos base with a non-carbonizing inorganic binder.
7. Straight line vertical ball bearing action.
8. The coils are readily changeable, even in the cabinet. Pull out the retainer spring, loosen yoke and take out the magnet, and the coil is free.
9. Overload Relays — Combination hand and automatic reset. Bimetallic type.
10. Heaters—Front mounted—accurate—trip ampere stamped on units.
SEND FOR NEW FEDERAL MOTOR CONTROL CATALOG 144 TODAY!
FEDERAL ELECTRIC PRODUCTS COMPANY, INC.
EXECUTIVE OFFICES: 50 PARIS ST., NEWARK 3, N. J. • PLANTS: Hartford, Conn., Newark, N. J.
Manufacturers of Motor Controls, Safety Switches, Circuit Breakers, Service Equipment, Panelboards

C. C. CADWALLADER

complete retirement from active work to enjoy a well earned rest.

Sterling Melcher, Detroit, succeeds Cadwallader as manager of the association. He brings with him a background of 10 years in public relations work with the Armstrong Cork Company.

CODE PROPOSALS BY SOUTHWESTERN SECTION IAEI

The Article 430 Committee of the Southwestern Section of the International Association of Electrical Inspectors and Chairmanned by Frank A. Short, have proposed changes and additions to that Code article for consideration in the prenaration of a new Code.

They point out that safety, as well as fire protection is needed in the writing of the Code. Where the original wiring rules for fire protection or protection of the equipment does not go far enough to protect the lives or bodies of those likely to come in contact with electrical equipment, it is often found necessary to make additional local or state regulations in the interest of human safety.

If the National Electrical Code is to be regarded as the single, uniform set of rules for the entire country then revisions to improve its safety provisions are in order. Such improvements to the Code itself will reduce the need or desire to require additional safeguards either in local ordinances or state safety orders.

Suggestions for changes in and additions to the 1940 National Electrical Code were submitted at the annual meeting held recently at Santa Cruz, California.

Although nearly all of the time during the three-day session was devoted to consideration of the suggestions submitted, there was not sufficient time to read all of them.

Article 430 was submitted without reading. Although there is not space enough here to outline all the changes proposed, only the more important suggestions are discussed and include the reasons why the Committee of the Southwestern Section propose these changes.

Most of the suggestions were the result of the field experience of the members of the Committee. Many of the suggestions are in line with the Electrical Safety

...and after installation, you can forget a SEALEDPOWER MOTOR

The Crocker-Wheeler **SEALED-POWER** Motor makes the maintenance man's job easy. Here's why:

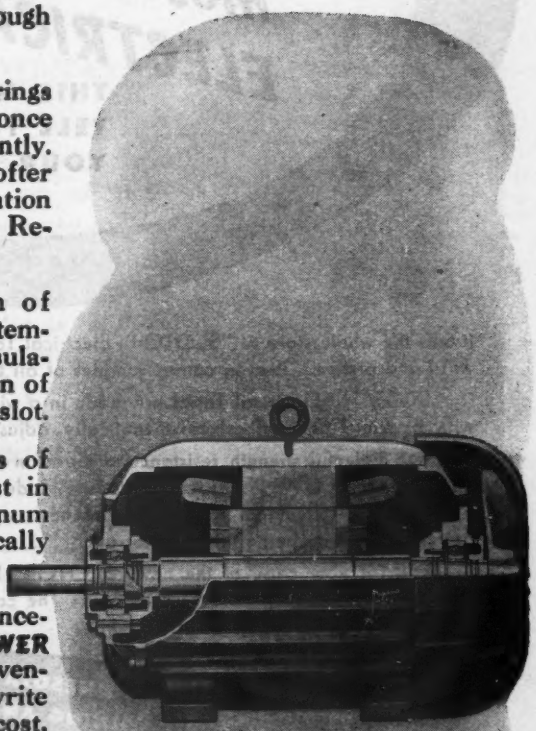
1. The totally-enclosed frame seals out harmful foreign matter. There is no danger of oil, corrosive liquids, acid or alkali fumes, air-borne moisture, steam, conducting dusts or metal chips, for example, causing premature breakdown of windings.

2. There are no ventilating passages in the frame to require periodic cleaning. Cooling air is blown over the outside surfaces of the motors, not through the frame.

3. Patented *Grooveseal* bearings require re-greasing only once a year or even less frequently. Seal permits use of softer grease, for better lubrication and longer bearing life. Retains grease.

4. Vacuum impregnation of windings reduces hotspot temperature and lengthens insulation life. Prevents vibration of wires inside or outside of slot.

5. Bars, fans and end rings of *Alucast* rotor are die cast in one operation from aluminum alloys, forming a practically indestructible rotor.



And yet, with all these maintenance-cutting advantages, **SEALEDPOWER** Motors cost no more than conventional fan-cooled types. Why not write for descriptive literature? No cost, no obligation.

CROCKER-WHEELER

A Division of JOSHUA HENDY IRON WORKS

AMPERE, NEW JERSEY

Branch Offices: BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DETROIT • LOS ANGELES • NEW YORK • PHILADELPHIA • PITTSBURGH • SAN FRANCISCO • WASHINGTON

It tells the whole story of "SCOTCH" Electrical Tapes and their application, by word and picture. It even carries samples of all the tapes listed.

"SCOTCH" Electrical Tapes are made in a wide range of tested properties, with backings and adhesives scientifically adjusted to varying requirements.

High dielectric strength, resistance to corrosion and firm adhesion are unfailing qualities of "SCOTCH" Electrical Tapes. Made to exact standards, every lot of "SCOTCH" Electrical Tape must conform completely with the most rigid requirements before being released for use.

Send for your copy of the new "SCOTCH" Electrical Tapes book today. You'll find it complete and very helpful. The coupon below is for your convenience.

3-M PRODUCTS — MINNESOTA MINING AND MANUFACTURING CO.
GENERAL OFFICES SAINT PAUL 6, MINN.
BRANCHES IN PRINCIPAL CITIES

MINNESOTA MINING & MANUFACTURING COMPANY EC-345
St. Paul 6, Minn.

Please send us a copy of your new book on "SCOTCH" Electrical Tapes.

Firm _____

Street _____ City _____

Zone _____ State _____ Signed _____
Title

"SCOTCH" IS THE TRADEMARK FOR ADHESIVE TAPE MADE IN U.S.A. BY MINNESOTA MINING & MANUFACTURING COMPANY

Orders of the Industrial Accident Commission of the State of California.

1. In practically all cases when a motor layout is made, the full-load current rating which will appear on the name-plate of the motors is not known, but the horsepower is known; therefore, it is impossible to base the size of the branch-circuit switch, fuse, wire, conduit, and running overcurrent protection on the actual number of amperes which will appear on the nameplates of the particular motors installed. In some cases, the difference between the actual amperes marked on the name-plate and the amperes given in Tables 22, 23, or 24 would make a difference in the size of the branch-circuit switch or the size of the wire or conduit.

Arguments between engineers, contractors, and inspectors can be avoided by using the arbitrary ampere ratings given in the Tables instead of the actual amperes given on a particular motor nameplate. The committee could see many advantages and no disadvantages in making it mandatory to use the full-load current ratings given in the Tables; therefore, it suggests the necessary changes in Sections 4304, 4305, 4312, 4314, 4322, 4323, 4331, 4342 and 4362 to accomplish this result.

2. Section 4312 in the 1940 National Electrical Code, which undertakes to set up the size of conductor for intermittent duty motors operating under different conditions, has been the subject of so much misunderstanding and controversy that the committee suggests the omission of the Table and the rewording of the rule to require a conductor size based on the horsepower of the motor, whether it is designed for constant duty or intermittent duty. It suggests a change in Section 4304 to require that the horsepower rating be given on the name-plate of all motors, whether constant duty or intermittent duty, so that in all cases the ampere rating can be taken from the Tables for the corresponding horsepower.

3. It is suggested that Sections 4327 and 4328 be changed to require that all a.c. motor running protective devices (other than fuses) be arranged to open simultaneously all ungrounded conductors to the motor. The committee felt that the change would be an added protection to the operator or electrician who might have occasion to do any work on a motor and who might neglect to open the disconnecting means if the motor were not running because the overload device had operated.

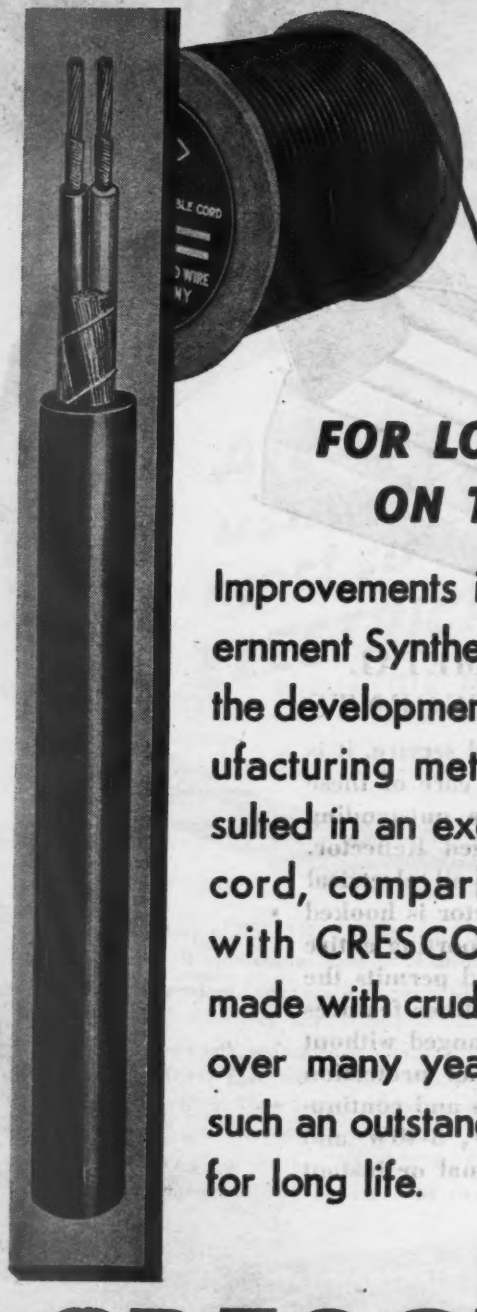
4. The committee felt that Section 4331 should be changed to provide that the running overload protective device should have a continuous current carrying capacity equal to the 125 percent setting which is permitted, since the motor might be overloaded to approximately 125 percent continuously without causing the overload device to operate. The same change was suggested in Sections 4340 and 4403 for the same reason.

5. The committee suggested a change in Section 4347 to require the fuse holders to be of sufficient capacity to accommodate the ordinary type of fuse of the maximum capacity permitted by the

ALL METAL
INDUSTRIAL FLUORESCENTS
Designed to facilitate installation and service, it is but a one man job to hang or take care of these new Lighting Products units. One outstanding feature is the L.P.I. patented Hinged Reflector. After the housing, which contains all electrical equipment, is hung, the metal reflector is hooked on. This relieves the worker of supporting entire reflector weight while closing up and permits the use of both hands while servicing. Other features are separate starters that can be changed without lamp removal, drop ends for socket protection and K.O.'s in ends for pull switches and continuous mounting. Available in 2-40W, 3-40W and 2-100W units with either conventional or instant start ballasts.
LIGHTING PRODUCTS INC.
HIGHLAND PARK — ILLINOIS

RUBBER POWER CABLES • VARNISHED CAMBRIC CABLES • PERMACORD • LEAD-ENCASED AND PARKWAY CABLES • SYNTHOL WIRES • WELDING CABLES • SHIPBOARD CABLES • IMPERIAL NEOPRENE JACKETED PORTABLE CABLES • ARMORED CABLE • CRESFLEX NON-METALLIC SHEATHED CABLE • SERVICE ENTRANCE CABLE • BUILDING WIRE

CRESCORD



RUBBER JACKETED PORTABLE CORD

FOR LONG SERVICE ON TOUGH JOBS

Improvements in Buna-S (Government Synthetic Rubber) and the development of better manufacturing methods have resulted in an excellent portable cord, comparing favorably with CRESCORD formerly made with crude rubber which over many years had earned such an outstanding reputation for long life.

CRESCENT

WIRE and CABLE

NEMA

CRESCENT INSULATED WIRE & CABLE CO.

TRENTON, N. J.

Tables. It would be impossible for an inspection department to have sufficient supervision over a plant to be sure that special type fuses would be available to replace any fuse which might blow.

6. The committee felt that all control circuits entering the controller for a particular motor should be arranged to be disconnected when the disconnecting means for that motor is opened, so that there would be no energized conductors in a controller when any work is to be done on that branch-circuit.

7. To Article 4402-c, the committee added the requirement that the disconnecting means for motors of more than 50 horsepower, operating at more than 300 volts, shall be rated at not less than 400 amperes. It was felt that 200 ampere switches were not safe for use on 60 or 75 horsepower 440 volt motors. Accident records seem to indicate that ampere-rated switches of 200 amperes and less will not interrupt locked-rotor current, but that 400 ampere and 600 ampere general use switches will.

8. The committee suggested the omission of 4410-c, which permits a single disconnecting means for a group of motors installed in the same room. It is necessary to be able to disconnect any one motor branch-circuit when work is to be done in that circuit without disconnecting all of the other motors supplied by a feeder regardless of location.

9. It was suggested that Section 4424 be reworded and Secton 4425 be omitted to provide for two general methods of protecting high-voltage feeders and branch-circuits; either circuit-breakers or fuses. Section 4424 was reworded to permit the use of different types of circuit-breakers and fuses, but to provide safe means for replacing fuses and re-establishing the circuit after faults.

10. The committee gave consideration to the rapid increase in the size of transformers supplying services to industrial plants, and suggested a new Section 4426 to provide for safe interrupting capacity of overcurrent devices for the high-voltage and low-voltage circuits, where transformers supplied by high-voltage feeders are located in the building.

11. A new Section 4434 was proposed to require that all motor control equipment be so enclosed that no live parts will be exposed to contact by persons or conducting material, and so that all of the manually operable parts can be operated from outside of the enclosure.

12. It was suggested that Sections 4435, 4436 and 4437 be changed to require the grounding of the frames of all fixed motors and most portable motors and to eliminate the present provision that the motor frame may be insulated from ground in lieu of grounding. Insulating the motor frame from ground would introduce a hazard to persons who might contact the frame and the ground if there was a contact between motor winding and frame, due to defective insulation.

Members of the Southwestern Section Article 430 Committee are: B. C. Hill, Oakland; R. H. Manahan, Laguna Beach; A. C. Veit; H. K. Winterer, and Frank A. Short, Chairman, all of Los Angeles.

HIGH FREQUENCY HEATING SESSION DRAWS 3000

From bobby pins and peanuts to heavy war material was the span of high frequency heating applications covered at a recent three-day conference in Chicago attended by some three thousand industrialists from Michigan, Indiana, Illinois and Wisconsin. Sponsored by the Great Lakes Power Club in cooperation with the Chicago Lighting Institute and designed to bring together plant men and high frequency heating experts for mutual consultation, the conference was divided into six sessions at which 13 manufacturers' high frequency engineers reviewed theory and applications and led forum discussions.

Each session was divided into three distinct parts: First, a technical dissertation by the experts; second, an open forum discussion with questions answered by the panel of experts; finally, a demonstration of the processes discussed earlier on standard high frequency equipment sent by the manufacturers and set up in the Commonwealth Edison Company auditorium in the Marquette Building. Specific processes covered included: Brazing and low temperature soldering; heat treatment of metals; application of dielectric heating to wood products, food processing, plastics and rubber; melting and heat treatment of large masses of metal; and forging of metals.

The prime advantage of applying induction heating to brazing and low temperature soldering lies in the ability to concentrate energy in the largest and often most difficult parts to heat, stated H. U. Hjermstad, Federal Electric Co., Chicago. Reporting successful high frequency heat treatment of metal parts ranging from 1/16th-in. to 48-in. diameter, Otto Weitmann, Lepel High Frequency Laboratories, New York City, outlined the advantages of such induction heating as: (1) Increased production; (2) elimination of warping and scale formation; (3) a quality control not otherwise possible.

In the far-off advance bases of military operation, the Army and Navy are using pre-wired and assembled high frequency induction heating furnaces to melt brass and steel, revealed F. T. Chestnut, Ajax Electrothermic Corp., Trenton, N. J., as he reviewed the development and application of induction heating furnaces. It's not unusual to bring some metals up to forging heat (850 degrees F.) in two seconds by induction heating compared to two hours by conventional methods, stated H. A. Strickland, Budd Wheel Company, Detroit, as he discussed this specific application.

While dielectric heating—used only with non-conducting, non-metallic materials—has had wide industrial application to binding of plywood, gluing of wood and formation of simple and complex wood curves, Dr. Paul Zottu, Girdler Corp., warned that, although technically possible, its use for drying or curing green lumber was relatively uneconomical. Asserting that it has been successfully applied to redrying of wood with less than 15 to 20 percent moisture content he

SILV-A-KING
PORCELAIN
ENAMELED
FLUORESCENT UNITS

SPECIFICATION
INDUSTRIAL UNIT

Tested and Certified by
RLM Standard Institute

For quality, adaptability, and economy in fluorescent lighting, ask for the Silv-A-King "Specification" unit. Here's a fluorescent assembly with important, exclusive features of design and construction—at a price no greater than that of most ordinary units! Detailed technical information is available on request. Write today for Bulletin No. 44 FS.

Here are just a few of the SILV-A-KING *features!*

Knockouts for conduit mounting.
Ears for chain suspension.
Slide-grip hangar grooves for U-type hanger straps, permitting positioning of straps at almost any location along entire length of hood.
Knockouts in end for either a pull-switch or coupling for continuous runs.

WRITE FOR BULLETINS 44FE AND 44FS.
Describing the "Economical" and Specification" units.

BRIGHT LIGHT REFLECTOR CO.
Metropolitan and Morgan Avenues • Brooklyn 6, N. Y.

SILV-A-KING LIGHTING EQUIPMENT

—for Heavy-duty Continuous Ventilating Service!

Buffalo direct-connected and belted disk fans are heavy-duty fans designed primarily for industrial ventilation. Motors are the standard makes usually employed for continuous service. All Buffalo fans are tested and rated according to methods approved by the Propeller Fan Manufacturers Association.

Buffalo Fans are GOOD FANS to sell—they are easy to install—they stay on the job—and they satisfy your customers.

Write for Bulletin 3222 which gives complete details.

Buffalo Forge Company
143 Mortimer St., Buffalo, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

ARMY E NAVY

"Buffalo"

FIRST FOR FANS

BREEZO FANS

cautioned that removal of large quantities of moisture from any product by dielectric heating is uneconomical.

The application of dielectric heating to preheating and curing of plastics rubber and fubber substitutes has the advantage of concentrating heat quickly within materials of poor thermal conductivity, explained V. W. Sherman, Federal Telephone and Radio Corp., Newark, N. J., while discussing this application.

Despite rapid strides in the application of dielectric heating in the food and drug fields—for sterilization, pasturization, cooking and enzyme control—certain limitations make it impractical on a commercial scale at present asserted Wiley Wenger, Radio Corporation of America, Chicago. These include: Lack of homogeneity in the product; cost of providing the required flexibility of apparatus; and lack of sufficient experimental data. Based on present rates of progress, there is a possibility of a more substantial application of high frequency to the food processing field in the future, Wenger indicated.

That high frequency induction and dielectric heating has a wide field of possible applications was clearly indicated by the report of Edwin D. Tillson who told the conference of his experiments in the Commonwealth Edison Company Laboratories in Chicago. More than 200 applications of these heating methods have been investigated during the past 13 months—ranging all the way from the tempering of "bobby pins" by induction heating to dielectric pre-heating of peanuts for peanut brittle, he revealed.

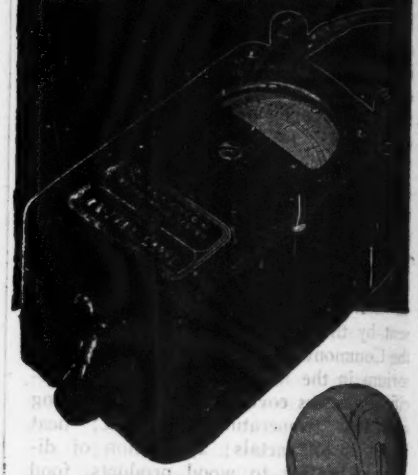
A short non-technical outline of the fundamentals of high frequency heating—indicating the limitation of induction heating to conducting metals, and dielectric heating to non-metallic, non-conducting materials—preceded the discussion of specific problems at each session. Participating in this phase of the program were J. P. Jordan, G. E. Co., Schenectady; J. W. Cable, Induction Heating Corp., New York City; Stanley Schneider, Westinghouse Elec. & Mfg. Co., Baltimore, Md.; Dr. Harry Osborn, Jr., Ohio Crankshaft Co., Cleveland; and Dr. Eugene Mittelmann, Illinois Tool Works, Chicago.

Organization of the conference program and demonstrations was under the direction of Carl Zersen, manager, Chicago Lighting Institute and W. M. Woll, Commonwealth Edison Co., and president of the Great Lakes Power Club.

ILLINOIS INSPECTORS STUDY ELECTRICAL ADVANCES

The direct effect of electrical industry technological progress on the present and future work of the electrical inspector was the central theme of the Fifteenth Annual Meeting of the Illinois Chapter, Western Section, International Association of Electrical Inspectors, held at Chicago's Hotel Sherman, Jan. 25-26. A comprehensive, meaty, educational program designed to give the inspector an inside glimpse of

HOLTZER-CABOT
ELECTRONIC
INSULATION
RESISTANCE TESTER



SPOTS FAULTY INSULATION

Generates full voltage regardless of cranking direction.

Visual indication of correct testing voltage.

Easy to read scale.

Light Weight.

Portable.

You can guard against possible insulation failures in electrical circuits and equipment by testing with the Holtzer-Cabot Insulation Resistance Tester. This portable self-contained unit spots faulty insulation before it can become dangerous. Here's how it works — connect terminal marked "L" to the electrical circuit and terminal "GRD" to a ground . . . rotate the handcrank of the generator at speed which lights up indicating buttons . . . reading on the scale indicates if insulation is faulty or not.
The Holtzer-Cabot Insulation Resistance Tester requires no batteries or external power supply. It is always ready to use in the plant, laboratory or field. The generator delivers 500 volts testing voltage regardless of cranking direction. Range is from 0 to 100 megohms. Protect your equipment from insulation failures by making periodic insulation tests with the Holtzer-Cabot Insulation Resistance Tester. Write for bulletin today.

HOLTZER-CABOT
Division of First Industrial Corporation
400 STUART STREET, BOSTON 17, MASS.

some of these recent developments drew a registration of 149 electrical inspectors, contractors and industry representatives to the two-day conference—one of the largest groups to attend an Illinois Chapter meeting.

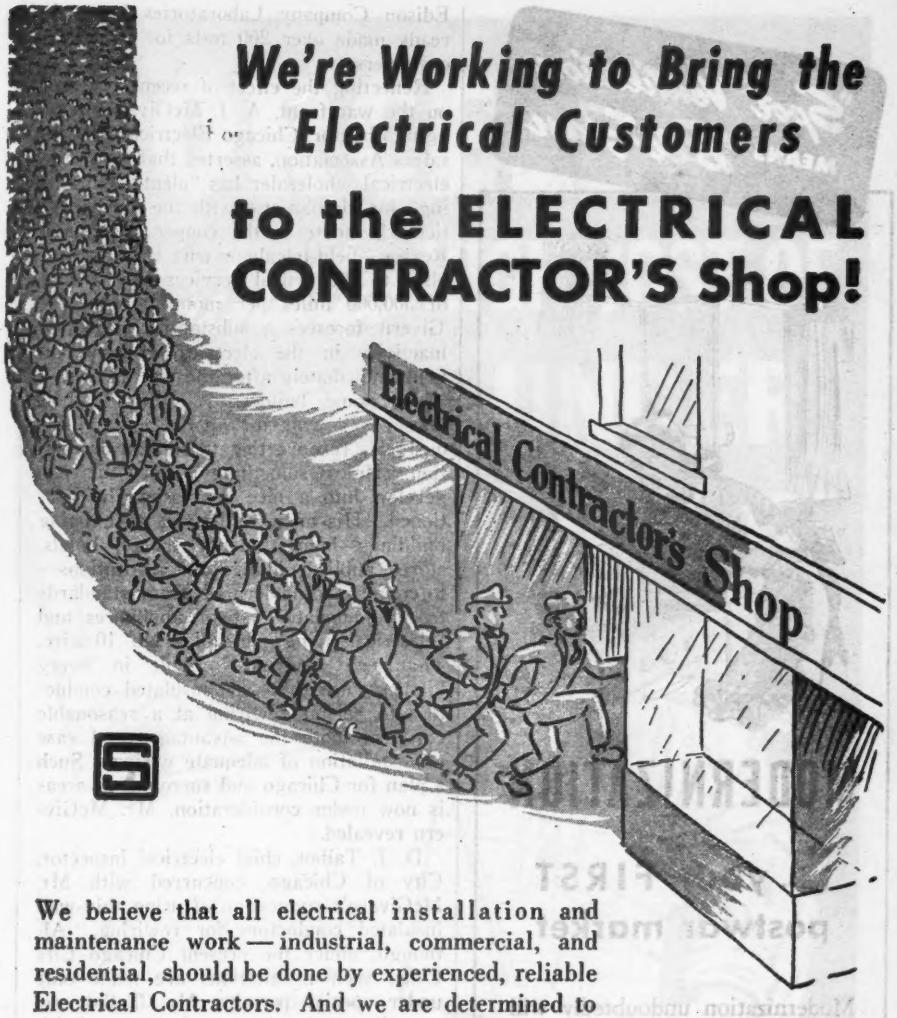
With an accelerated demand for explosion-proof and dust-tight electrical equipment in war plants, many inspectors have had the direct responsibility of passing on the safety of equipment located in hazardous areas. At the initial session of this meeting they learned the safety features, construction details and methods of testing such equipment for approval from A. F. Matson, associate engineer, chemical department, Underwriters' Laboratories, Inc., Chicago. Due to wartime use of magnesium and aluminum alloys—processes that undoubtedly will extend into peacetime production—the Laboratories have tested and approved equipment designed for use in metal dust atmosphere (Class II, Group E), he revealed. As yet, no equipment has been tested or approved for use in atmospheres of dusts of explosives (gun powder, T.N.T., etc.), he added, suggesting that such equipment, if practicable, be located outside the hazardous areas. Such equipment should be Class II, Group E type with relatively smooth exterior surfaces (explosion-proof equipment is not designed to exclude fine dust, but to confine possible gaseous explosions within the enclosure without rupturing it), he asserted.

Many questions concerning the operation, safety features, and maintenance of the low voltage (450 volts, operating; 750 volts, start) cold cathode lighting fixture incorporating a safety cutout were answered in a clear-cut presentation by R. Hultgren, vice-president, General Luminescent Corp., Chicago. Predicting the safe use of cold cathode lighting in the home—fixtures to have a safety cutout and an open circuit voltage not exceeding 600 volts—Mr. Hultgren based his conclusion on the premise that trouble-free, long-life lamps will eliminate tendency to "play around" with the lighting system.

Commenting on the relative merits of cold vs. hot cathode lighting systems, L. V. James, General Electric Co., Chicago, revealed that past experience and exhaustive tests have led to extended life ratings on hot cathode fluorescent lamps—new ratings being based on the number of burning hours per start of lamp.

If any mystery (in the minds of those present) surrounded the incredible time saving and localized heating features of high frequency heating, such confusion vanished after W. M. Woll, industrial heating engineer, Commonwealth Edison Co., Chicago, presented the fundamental theory of induction and dielectric heating in non-technical terms. Inspectors had a new conception of our miraculous war production feats when they learned of heating time being reduced from many hours to minutes and seconds. Picturing high frequency heating equipment as a grown-up radio set, Mr. Woll, related the need for electronically trained men to install and service such machines. Concluding, he predicted a broad postwar market for high frequency heating applications; revealed that the Commonwealth

We're Working to Bring the Electrical Customers to the ELECTRICAL CONTRACTOR'S Shop!



We believe that all electrical installation and maintenance work — industrial, commercial, and residential, should be done by experienced, reliable Electrical Contractors. And we are determined to do everything we can to bring the electrical business back to the shop of the Electrical Contractor, *where it belongs.*

We have therefore launched an advertising campaign in which we are going to tell electrical buyers everywhere why IT PAYS to consult a competent Electrical Contractor whenever there is electrical power, lighting, or control equipment to be installed or repaired.

We are going to tell the public that the Electrical Contractor is the *only* man who has the training, experience, and equipment to do good electrical work . . . that the Electrical Contractor *protects the public safety* through his expert knowledge and observance of local codes and regulations. And we are going to urge all branches of the Electrical Industry to support and protect the Electrical Contractor.

This advertising is prepared to help YOU — Mr. Contractor. Watch for it!

Sherman

- Soldering Lugs
- Solderless Lugs
- Set Screw Connectors
- Bolted Connectors
- Fixture Connectors
- Ground Clamps
- Rigid Ground Fittings
- Electrical Terminals
- Battery Connectors
- Splicing Sleeves
- Wedge Grip Connectors

H. B. SHERMAN MFG. CO.
BATTLE CREEK, MICHIGAN

Sherman ELECTRICAL SPECIALTIES

"Spot" Ventilation MEANS Blo-Fan

MODERNIZATION

...your FIRST postwar market

Modernization undoubtedly will be well under way before new construction is permitted. "Spot" ventilation that rids the home of unwanted odors at their sources will be one of the first "musts."

Blo-Fans will answer this ventilating problem surer and more efficiently than any other device. Installed in kitchen, bathroom and gameroom ceilings, Blo-Fans provide the volume of a breeze fan plus the power of a blower. They whisk away the unwanted air before it can reach other rooms. Cost will be so small most homes can use several Blo-Fans.

Your Jobber will have BLO-FANS as soon as possible.

Send for your copy of FREE booklet "DANGER SPOTS"

PRYNE & CO., INC.
1245 E. 33rd St. • LOS ANGELES 54
BRANCHES (To be re-established after the war) SAN FRANCISCO, SEATTLE, CHICAGO, NEW YORK

Edison Company Laboratories have already made over 200 tests for industrial customers.

Reflecting the effect of recent reverses on the war front, A. J. McGivern, managing director, Chicago Electrical Wholesalers Association, asserted that today the electrical wholesaler has "plenty of nothing" for civilian use with the pinch particularly acute in the copper wire field. Reason—field telephone wire is being supplied to the armed services at the rate of 300,000 miles per month. Mr. McGivern foresees a substantial period of inactivity in the electrical construction field immediately after the war is over—while home builders wait for lumber, housewives wait for appliances, and industry is reconverting to civilian production. Unless something is done this can develop into a nice depression, he cautioned. His answer: Rewire all existing buildings—homes, plants, offices, hotels, stores, public buildings and institutions—to conform to modern adequacy standards to accommodate postwar appliances and "electrical living"; install a No. 10 wire, 20-ampere appliance circuit in every kitchen; use thin-wall insulated conductors to permit rewiring at a reasonable cost; promote the advantages and ease of installation of adequate wiring. Such a plan for Chicago and surrounding areas is now under consideration, Mr. McGivern revealed.

D. J. Talbot, chief electrical inspector, City of Chicago, concurred with Mr. McGivern's suggestion of using thin-wall insulated conductors for rewiring. Although, under the present Chicago City Code, such installations are made only under special permits, Mr. Talbot reported no adverse experiences, and felt such wiring would be acceptable.

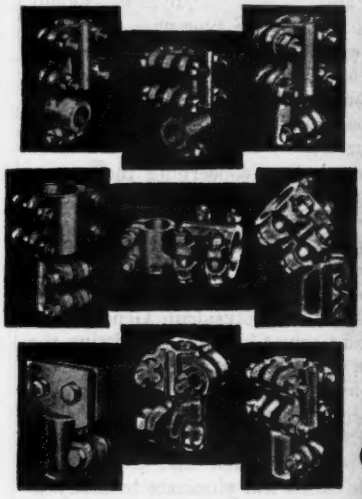
Inspectors and industry groups who oppose bare (uninsulated) neutral wiring systems will have a powerful ally in the International Brotherhood of Electrical Workers according to William D. Walker, International Vice-president, IBEW, Philadelphia, Pa., who addressed the conference in the absence of International President E. J. Brown. The IBEW is now taking active interest in code matters, Mr. Walker stated and revealed the creation of a National Advisory Code Committee composed of five electrical inspectors active in public work (D. J. Talbot, Chicago, is chairman). IBEW takes the position that wiring has been the neglected branch of the electrical industry; that it has been given too much destructive attention—allowed to serve as an obstacle to industrial expansion; that wiring must take its rightful, equitable, mature place in electrical services, he added. Asserting that sheer cheapness has been too much of a fetish, he reported that bare neutral wiring, as all destructive moves in National and Municipal Codes, will always be opposed by the IBEW (E. J. Brown is the IBEW member of the Electrical Committee; W. D. Walker, alternate).

If any inspectors harbored any doubts as to the importance of their work in the electrical industry and most particularly in the war effort, their fears were allayed by Richard Vernor, president, NFPA. Chicago, and J. Walter Collins, secretary,

"You select EXACTLY what you need—

—from the COMPLETE line"

Stud Connectors and Solderless Terminal Adapters for distribution and power transformers . . . for connecting to cable, pipe or bus bar . . . in line or at any angle. Connectors with reversible clamping caps take two different ranges of cable sizes. Furnished for any number of conductors. A few of Penn-Union's many types:



Also . . . the most complete line of Service Connectors, Cable Taps, Tees . . . Straight and Parallel Connectors . . . Bus Supports, Spacers . . . Grounding Clamps, Terminal Lugs, etc. etc.

Penn-Union conductor fittings are the first choice of leading utilities, industrials, electrical manufacturers and contractors—because they have found that *"Penn-Union" on a fitting is their best guarantee of Dependability.* Write for Catalog.

PENN-UNION ELECTRIC CORPORATION
ERIE, PA. *Sold by Leading Jobbers*

PENN-UNION
Conductor Fittings

Electrical Contractors Association of City of Chicago. After briefly outlining the organization and activities of the NFPA, Mr. Vernor reminded the electrical inspectors of their responsible work in preventing loss of life, property and materiel—a very worthy contribution to the war effort.

Emphasizing the part that inspection has played in the advancement of the electrical industry, Mr. Collins, compared the inspector to an arbiter who, through the interpretation and application of codes and standards, has instilled confidence in the public and kept all branches of the industry in line—using safety as the yardstick. The rules upon which material and equipment standardization and installation practices are based are the result of careful analyses of electrical requirement and mechanical durability, he asserted.

With a new National Electrical Code in the making, a review of possible changes occupied a prominent place on the program. As outlined briefly by Victor H. Tousley, electrical field engineer, NFPA, Chicago, recommended changes and additions include, among others, infra-red systems, welders, control circuits, network systems, high-voltage lighting in the home, recognition of the Type S fuse, and a revised article on conductors. Briefly the conductor article will be simplified providing two types of insulation covering all installations—Type RP (30 percent) insulation characteristics for all sizes from No. 14 to No. 7 incl.; Type RH insulation characteristics for No. 6 and larger. Insulation will be 1/64th-inch less and carrying capacities will approximate those of the 1937 Code. Recommendations call for the elimination of No. 8 and No. 10 and the substitution of No. 7 and No. 9 sizes.

At the business session following a discussion of inspectors' problems, the following officers were elected: Chairman, L. E. Ewald, Commonwealth Edison Co., Chicago; first vice-chairman, E. E. Dodds, city inspector, Chicago; second vice-chairman, H. C. Fieden, city inspector, Moline, Ill.; third vice-chairman, J. A. Trovillo, asst. secretary, Underwriters' Laboratories, Inc., Chicago; secretary-treasurer, W. J. Alcock, Underwriters' Laboratories, Chicago. The Executive Committee is comprised of: Chairman, J. T. Swanson, city inspector, Rockford, Ill.; P. J. Markey, Commonwealth Edison Co., Chicago; Emil DeHaan, contractor, Chicago; and J. J. Smith, Wadsworth Manufacturing Co., Chicago.

KENTUCKY INSPECTORS FAVOR BARE NEUTRAL

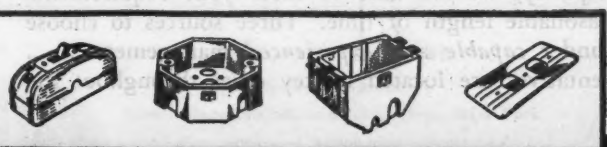
Safety considerations in electrical wiring systems was the central theme of the Seventeenth Annual Meeting of the Kentucky Chapter, Western Section, International Association of Electrical Inspectors, held at the Hotel Seelbach, Louisville, Kentucky, Jan. 11-12. A full pro-

PORCELAIN

Eliminates HIGH COST OF UNDER WIRING!

● **In wartime or peacetime—PORCELAIN Protected Wiring Systems offer unbeatable advantages for all types of installations—residential, rural, commercial and industrial! The modern Porcelain way eliminates HIGH COST OF UNDER WIRING. In an underwired home, the cost of operating appliances is materially higher—thus *adequate* wiring quickly *pays for itself!* And the cost of wiring with sufficient capacity is very little more than the cost of a poor inadequate system.**

Wire for tomorrow with PP knob-and-tube wiring! The nonmetallic way is the safe, economical and durable way. Your friendly Electrical Inspector can give you many helpful facts about fire prevention offered by knob-and-tube wiring. Write for wiring manual.



PORCELAIN PRODUCTS, Inc.
FINDLAY, OHIO

Wire Today for Tomorrow's Load

THE IWI MAN WITH A WISE PLAN *finds*

TAYLOR FIBRE

can be tailored to meet customer's exacting requirements.

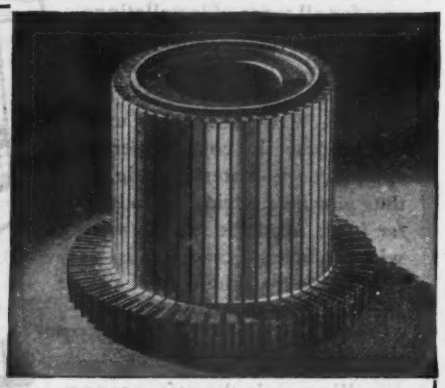
Fine fibre and phenol fibre available in rods, sheets, tubing and washers.

A variety of grades, sizes and thicknesses, all listed in the IWI Blue Catalog for your picking and purchasing convenience.

INSULATION & WIRES, INC.

2127 PINE STREET • ST. LOUIS, MO.

A MESSAGE to *Electric Motor* REPAIR MEN



For the past three years it has been extremely difficult for us to fill orders from our many motor repair shop friends. This was due to high priority ratings and the fact that twenty-four hours a day were not enough to fill all of the orders for commutators going into planes, tanks, ships and other fighting equipment . . . Today because of our vastly increased capacity, we are able to meet your requirements within a reasonable length of time. Three sources to choose from—all under *capable* and *experienced* management . . . Our representatives are located in key cities throughout the nation.

Over Ten Million Since Pearl Harbor

TOLEDO STANDARD COMMUTATOR CO. – Toledo 6, Ohio
HOMER COMMUTATOR CORP. – Cleveland 3, Ohio
HILLSDALE COMMUTATOR CO. – Hillsdale, Michigan

THE NATION'S LARGEST EXCLUSIVE MANUFACTURERS OF QUALITY COMMUTATORS

gram drew more than 100 delegates to the two-day session.

The "how and why" of the bare neutral wiring system was presented at the opening session by J. C. Runyon, Falls Church, Va., a consulting engineer who has made a comprehensive study of the subject. Referring to an engineering investigation of bare neutral systems that he had made in 1934, with prevention of fire and life hazards uppermost in his mind, Mr. Runyon observed that, fundamentally, there is nothing wrong with the bare neutral in principle. The prime obstacle, he related, was the development of wiring methods and fittings required by early designs—thus creating a confusion in the industry. Outlining the salient features of the system—a controlled, low-resistance permanent ground connection (a value of less than ½ ohm on each branch circuit will pass enough current on a fault short circuit to open a 200-amp., protective device); permanent identification of the neutral wire; a saving in rubber and metallic conduit—Mr. Runyon declared that industry's 20 year trial period had developed a noteworthy expansion in acceptance of bare neutral wiring. Many prominent locations have accepted the system (Evansville, Ind. approved trial installations in 1928; Louisville, Ky. also did at that time and has since 1935, on advance applications, approved it for all classes of work) which has been in successful operation for many years, he revealed, adding that in his opinion, bare neutral is here to stay and should be given recognition by appropriate rules in the National Electrical Code.

Following the conclusion of this presentation the Kentucky inspectors by resolution, went on record as ". . . favoring the use of the bare neutral system of wiring . . . that the bare neutral conductor be required to be bonded to all metallic enclosures through which it passes."

Recounting the benefits which the pub-

HIGH FREQUENCY HEATING demonstrations drew large crowds to a recent conference in Chicago. Here a group of industrialists watches a two-station, 30 kw., 9600 cycle Tocco Jr. (Ohio Crankshaft Co.) induction heating unit in operation.

HONORED when he retired from business after some 40 years, George Brouilet, manager of the electrical department of Klim Co., electrical and plumbing contractors of San Francisco, gave sage advice to fellow members of the San Francisco Electrical Contractors Assn. Seated at the head table with him, left to right, are Edward Scott, secretary and George Abbett, president, until recently.

lic derives from Underwriters' Laboratories' Listings, J. M. Salling, assistant superintendent, Label Service, Underwriters Laboratories, Inc., Chicago, outlined the operation of the testing and labeling services of that organization. Citing that the main objective of the Laboratories was to reduce to a reasonable degree the fire and accident hazard inherent in the design and construction of devices, appliances and materials, Mr. Salling revealed that approximately 50 percent of the devices submitted fail to comply with the requirements when first tested. After a device is approved, the Laboratories operate a follow-up inspection service in the manufacturer's plant to assure subsequent production being up to standards, he added. More and more inspection authorities, contractors and merchandising organizations are insisting on the use of listed products only, he concluded.

Following Mr. Salling's talk, the Chapter passed a resolution suggesting that ". . . manufacturers of non-metallic sheathed cable be required to stamp a plainly visible marking, at 3-foot intervals, on the outer braid of the cable assembly indicating U.L. approval . . . type, size and number of individual conductors within the cable assembly."

The Adequate Wiring Committee of the Kentucky Chapter is active, reported R. W. Wilson, chairman, who advised that 50,000 copies of a booklet on the subject have been printed by the Chapter and are ready for distribution. Acknowledging that the war has stymied the AW program, Mr. Wilson emphasized the *need of educating the public now* so the people will be ready to accept adequate wiring in the postwar period when hundreds of new electrical appliances will dictate adequate electrical systems for efficient operation.

The mechanics of producing a new and

SAFETY

FOR LINEMEN WITH "KLEIN-KORD"

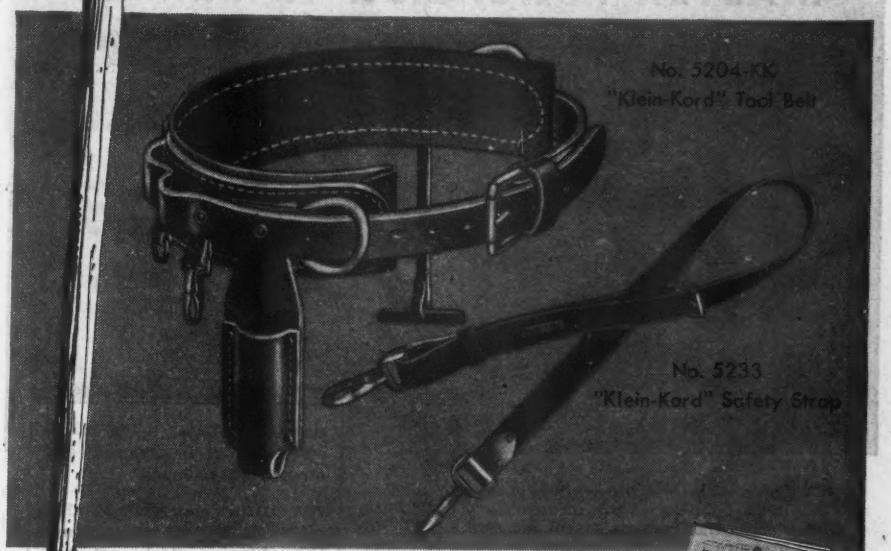
"Klein-Kord" is an exclusive material developed by Mathias Klein & Sons for use in linemen's safety straps, belts and climber straps.

It is made of a number of layers of long-staple cotton of special weave, each ply laid in rubber and vulcanized. This construction permits the use of a tongue buckle, eliminating the danger of slipping or excessive wear characteristic of a friction-type buckle.

The tensile strength of "Klein-Kord"—its resistance to ripping at the buckle—provides a full factor of safety. It does not stretch under load; is uniform in quality; and resists accidental damage from cuts, heat, etc.

"Klein-Kord" has behind it several years of actual service and today is specified exclusively by many of the largest utility companies.

Climbing equipment of "Klein-Kord" will assure the maximum in safety and comfort to the man on the pole.



ASK YOUR SUPPLIER

Foreign Distributor:

International Standard Electric Corp., New York

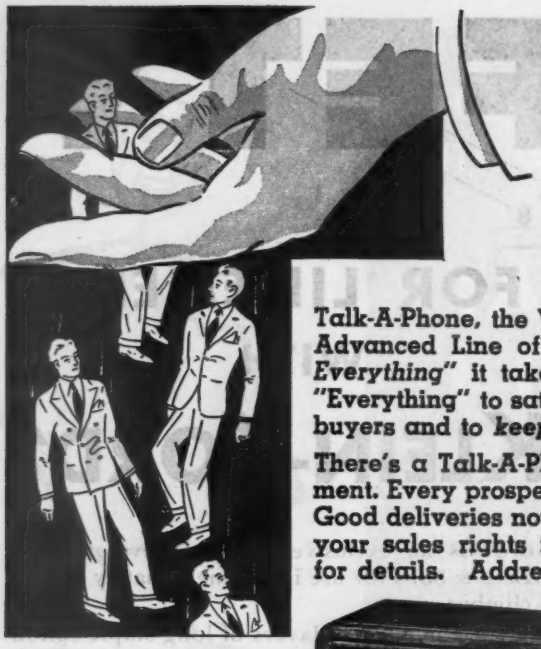
Safety engineers, purchasing agents and others interested in linemen's equipment can obtain a folder on "Klein-Kord" on request. Write for your copy.

Since 1857

Mathias KLEIN & Sons

Established 1857 — Chicago, Ill., U.S.A.

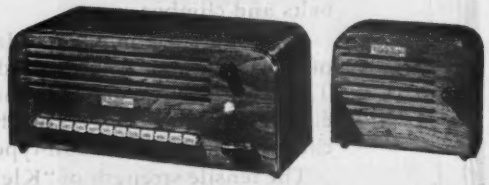
3200 BELMONT AVENUE CHICAGO 18, ILLINOIS



Why **Let Profitable Trade Slip Through** *Your* **Fingers?**

Talk-A-Phone, the World's Most Complete and Advanced Line of Inter-Communication *"Has Everything"* it takes to promote quick sales. "Everything" to satisfy the most discriminating buyers and to keep them satisfied.

There's a Talk-A-Phone unit for every requirement. Every prospect a live potential customer. Good deliveries now. Rigid jobber policy gives your sales rights iron-clad protection. Write for details. Address Dept. IA.

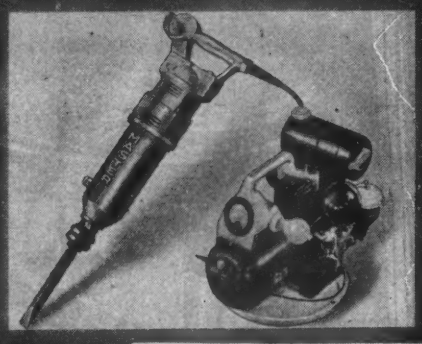


Talk-A-Phone Mfg. Co.

1512 So. Pulaski Rd. Chicago 23, Ill.

MASTER Power Blow HAMMERS

Most powerful...most versatile electric hammers made!



Save time . . . last longer

FOR DRILLING ½" up to 2" diameter holes in concrete and other hard materials.

FOR CUTTING concrete and other materials. For vibrating, tamping, chipping steel, cast iron and wood...scaling and caulking...peening welds and other heavy work.

FOR SPADING, cutting clay and similar materials.

Available with tools for drilling, cutting or spading. Will do light duty work or any heavy duty work. The Master Hammer runs without striking a blow until pressure is applied, enabling operator to control blow as job requires. Easy and economical to operate. Built for light weight and long service. Used throughout the world. Power blow hammers operate on 115 volt AC or DC, 25, 50, or 60 cycle. If no electricity is available use Master Portable Generator Plant Model 650 (illustrated above).

Write for Bulletin 500 for complete details.

MASTER VIBRATOR COMPANY

Dayton 1, Ohio • Distributors throughout United States and Canada

Products Include: Concrete Vibrators, Gas or Electric Surfacing Attachments, High Speed Tools • Vibratory Concrete Finishing Screeds • Rotary Concrete Floor Finishing Machines • Portable Gas Electric Generator Plants, 500 Watt to 17000 Watt, Voltage Regulators and Portable Mountings Optional • Master Flood and Shovel Lights • Electric or Gas Engine Driven Power Blow Hammers

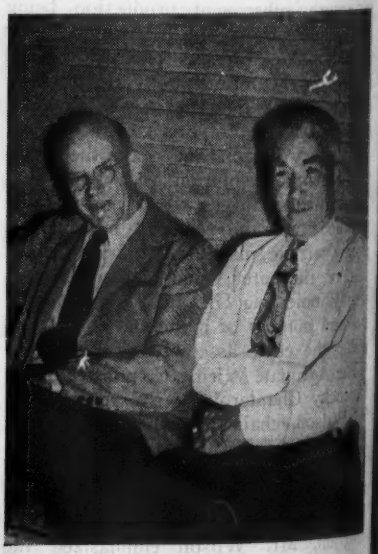
revised National Electrical Code were reviewed by Victor H. Tousley, electrical field engineer, National Fire Protection Association, Chicago. Registrants had a clearer conception of Code making after he had discussed some of the problems confronting special sub-committees and gave them a preview of some of the changes that are up for consideration.

At the business session immediately following an "unusual problems" period, the following officers were elected for 1945: chairman, E. W. Landmeier, Covington; vice-chairman, E. H. Tichenor, Louisville; secretary-treasurer, V. F. Knadler, Louisville. The executive committee is composed of past-chairman R. J. Seiler, Covington; J. J. Casey, W. D. Roach, E. H. Rueppel, all of Louisville; W. H. Waller, Hopkinsville; and E. M. Nelson, Chicago, Illinois.

CHICAGO E.M.E.'S HEAR SPOT CONVERSION STORY

A subject close to the heart of every plant electrical man—spot conversion of a-c to d-c—was the headliner for the first 1945 meeting of the Electrical Maintenance Engineers of Chicago at their Roby, Indiana rendezvous. W. R. Hough, product division engineer, Reliance Electric and Engineering Company, Cleveland, told the story to some 135 maintenance electricians and electrical engineers from Chicago area industries.

Classifying spot conversion as the simplified electrical distribution system for the postwar plant (where considerable d-c is required for machine tool operation), Mr. Hough traced the development of the Reliance V-S Drive—a packaged variable-voltage, variable speed, motor generated drive designed to conserve floor space and reduce cost of machine tool installations. This unit—similar to the Ward-



REUNION after 32 years. Old times and interim experiences are recounted by L. T. Allen, Allen Electric Co., Tulsa, Oklahoma and E. P. Fogarty, Fogarty Electric Co., Cincinnati, Ohio, who used to work together in Cincinnati more than a quarter century ago.

THE A B C'S of high frequency heating—both induction and dielectric— are presented to the Illinois Chapter, IAEI at its recent Chicago meeting by Willard M. Woll, industrial heating engineer, Commonwealth Edison Co., Chicago.

Leonard system—is the heart of the spot conversion technique as applied to electrical distribution systems.

After having installed a number of these units on machine tools and on special war plant equipment requiring auxiliary direct current power, Reliance hit upon the idea of making such units an integral part of the electrical distribution thus eliminating the necessity of duplicate feeders—one a-c and one d-c. Now that their own plant is going through a rewiring and electrical expansion program, they successfully applied this spot conversion technique, distributing only alternating current and using a V-S unit wherever variable speed d-c motors are needed on equipment.

Outstanding advantages of spot conversion according to Mr. Hough are:

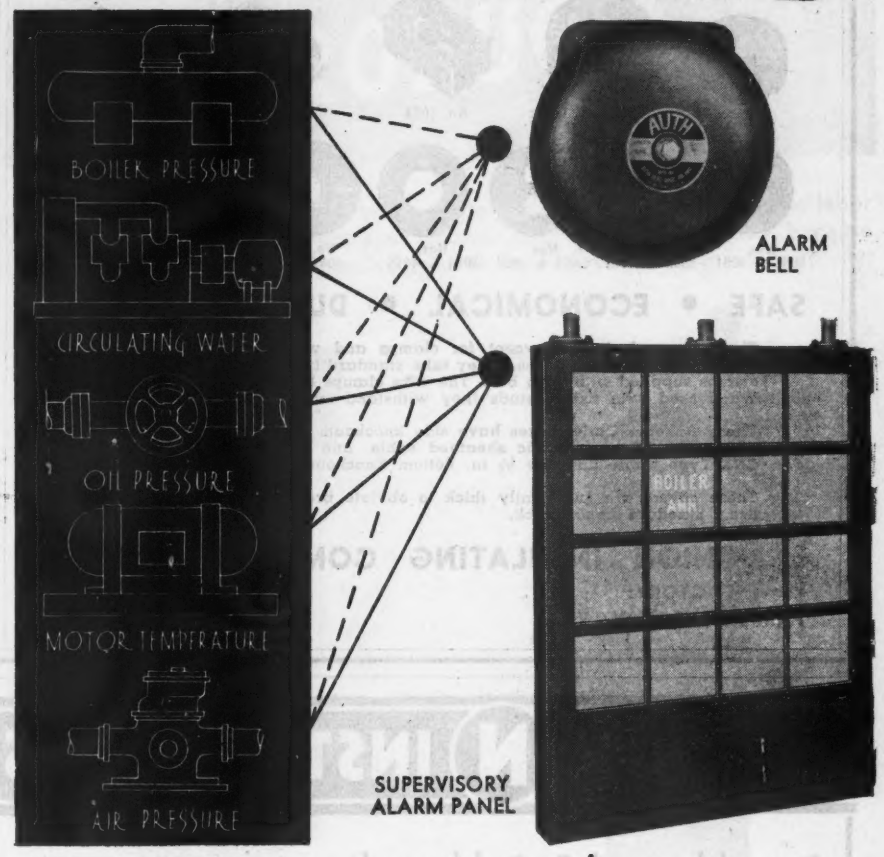
1. Elimination of duplicate electrical distribution for a-c and d-c.
2. Use of the V-S Drive with its 10 to 1 speed range permits increased production (only one set of reduction gears with shaft is necessary on the machine); facilitates rebuilding of old machines for increased output.
3. The design and operator control of a machine tool can be greatly simplified by applying the V-S Drive.

Possible postwar uses predicted by Mr. Hough include: built in drives on lathes, boring mills, thread grinders and other machine tools; alternating current systems on ships (now being considered) with spot conversion equipment for specific d-c applications such as winch motors.

While discussing the electronic type equipment—conversion affected through electronic tubes—Mr. Hough revealed one marked advantage over the motor-generator type. That is: Less speed drop

AUTH SIGNALS
for INDUSTRIAL MAINTENANCE

AUTH



THE BEST DEFENSE . . .

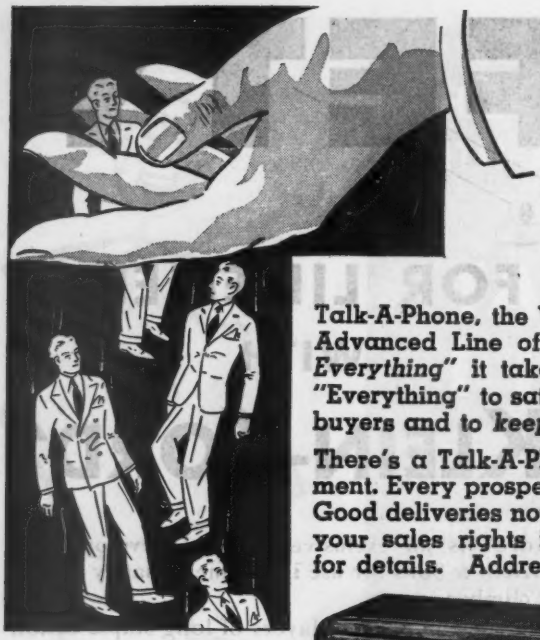
is often offense. Don't wait for trouble to develop on costly and critical plant equipment — *stop it before it strikes.*

Auth Supervisory Alarm Panels operate in direct connection with pressure switches, temperature switches, float switches, auxiliary circuit breaker contacts, etc. They are designed to indicate both visually and audibly the existence and location of abnormal conditions such as oil temperature changes, overheated bearings, increased or decreased pressure, opening of circuit breakers, high or low tank levels, etc. The audible signal shouts a warning — the panel shows at a glance where the trouble lies — *before, not after, the damage is done.*

Auth Supervisory Alarm Panels are custom built to suit specific requirements. All types and models are available. Our engineers will advise you and supply typical drawings upon receipt of details.

USE AUTH SIGNALS FOR ALL SIGNALING PURPOSES

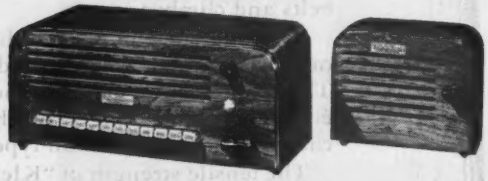
AUTH ELECTRICAL SPECIALTY CO., Inc.
422 E. 53rd St., New York 22, N. Y.
Offices in principal cities



Why Let Profitable Trade Slip Through *Your* Fingers?

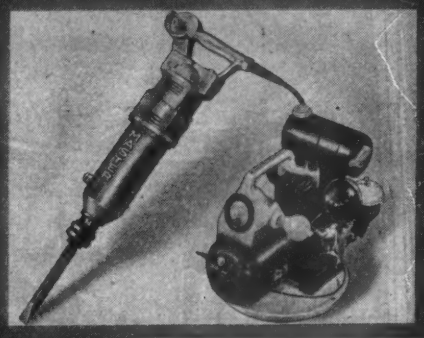
Talk-A-Phone, the World's Most Complete and Advanced Line of Inter-Communication *"Has Everything"* it takes to promote quick sales. "Everything" to satisfy the most discriminating buyers and to keep them satisfied.

There's a Talk-A-Phone unit for every requirement. Every prospect a live potential customer. Good deliveries now. Rigid jobber policy gives your sales rights iron-clad protection. Write for details. Address Dept. IA.



Talk-A-Phone Mfg. Co.
1512 So. Pulaski Rd. Chicago 23, Ill.

MASTER Power Blow HAMMERS
Most powerful..most versatile electric hammers made!



Save time . . . last longer

Available with tools for drilling, cutting or spading. Will do light duty work or any heavy duty work. The Master Hammer runs without striking a blow until pressure is applied, enabling operator to control blow as job requires. Easy and economical to operate. Built for light weight and long service. Used throughout the world. Power blow hammers operate on 115 volt AC or DC, 25, 50, or 60 cycle. If no electricity is available use Master Portable Generator Plant Model 650 (illustrated above).

Write for Bulletin 500 for complete details.

FOR DRILLING ½" up to 2" diameter holes in concrete and other hard materials.

FOR CUTTING concrete and other materials. For vibrating, tamping, chipping steel, cast iron and wood...scaling and caulking...peening welds and other heavy work.

FOR SPADING, cutting clay and similar materials.

MASTER VIBRATOR COMPANY
Dayton 1, Ohio • Distributors throughout United States and Canada
Products Include: Concrete Vibrators Gas or Electric Surfacing Attachments, High Speed Tools • Vibratory Concrete Finishing Screeds • Rotary Concrete Floor Finishing Machines • Portable Gas Electric Generator Plants, 500 Watt to 17000 Watt, Voltage Regulators and Portable Mountings Optional • Master Flood and Shovel Lights • Electric or Gas Engine Driven Power Blow Hammers

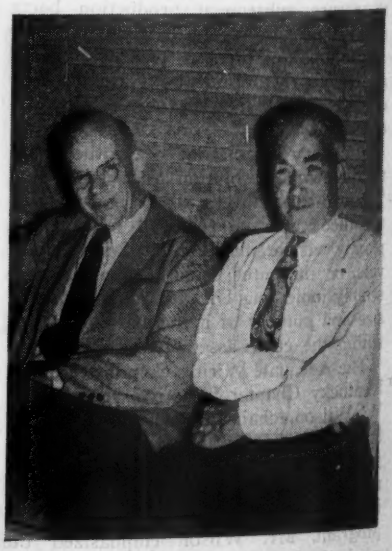
revised National Electrical Code were reviewed by Victor H. Tousley, electrical field engineer, National Fire Protection Association, Chicago. Registrants had a clearer conception of Code making after he had discussed some of the problems confronting special sub-committees and gave them a preview of some of the changes that are up for consideration.

At the business session immediately following an "unusual problems" period, the following officers were elected for 1945: chairman, E. W. Landmeier, Covington; vice-chairman, E. H. Tichenor, Louisville; secretary-treasurer, V. F. Knadler, Louisville. The executive committee is composed of past-chairman R. J. Seiler, Covington; J. J. Casey, W. D. Roach, E. H. Rueppel, all of Louisville; W. H. Waller, Hopkinsville; and E. M. Nelson, Chicago, Illinois.

CHICAGO E.M.E.'S HEAR SPOT CONVERSION STORY

A subject close to the heart of every plant electrical man—spot conversion of a-c to d-c—was the headliner for the first 1945 meeting of the Electrical Maintenance Engineers of Chicago at their Roby, Indiana rendezvous. W. R. Hough, product division engineer, Reliance Electric and Engineering Company, Cleveland, told the story to some 135 maintenance electricians and electrical engineers from Chicago area industries.

Classifying spot conversion as the simplified electrical distribution system for the postwar plant (where considerable d-c is required for machine tool operation), Mr. Hough traced the development of the Reliance V-S Drive—a packaged variable-voltage, variable speed, motor generated drive designed to conserve floor space and reduce cost of machine tool installations. This unit—similar to the Ward-



REUNION after 32 years. Old times and interim experiences are recounted by L. T. Allen, Allen Electric Co., Tulsa, Oklahoma and E. P. Fogarty, Fogarty Electric Co., Cincinnati, Ohio, who used to work together in Cincinnati more than a quarter century ago.

THE A B C'S of high frequency heating—both induction and dielectric— are presented to the Illinois Chapter, IAEI at its recent Chicago meeting by Willard M. Woll, industrial heating engineer, Commonwealth Edison Co., Chicago.

Leonard system—is the heart of the spot conversion technique as applied to electrical distribution systems.

After having installed a number of these units on machine tools and on special war plant equipment requiring auxiliary direct current power, Reliance hit upon the idea of making such units an integral part of the electrical distribution thus eliminating the necessity of duplicate feeders—one a-c and one d-c. Now that their own plant is going through a rewiring and electrical expansion program, they successfully applied this spot conversion technique, distributing only alternating current and using a V-S unit wherever variable speed d-c motors are needed on equipment.

Outstanding advantages of spot conversion according to Mr. Hough are:

1. Elimination of duplicate electrical distribution for a-c and d-c.

2. Use of the V-S Drive with its 10 to 1 speed range permits increased production (only one set of reduction gears with shaft is necessary on the machine); facilitates rebuilding of old machines for increased output.

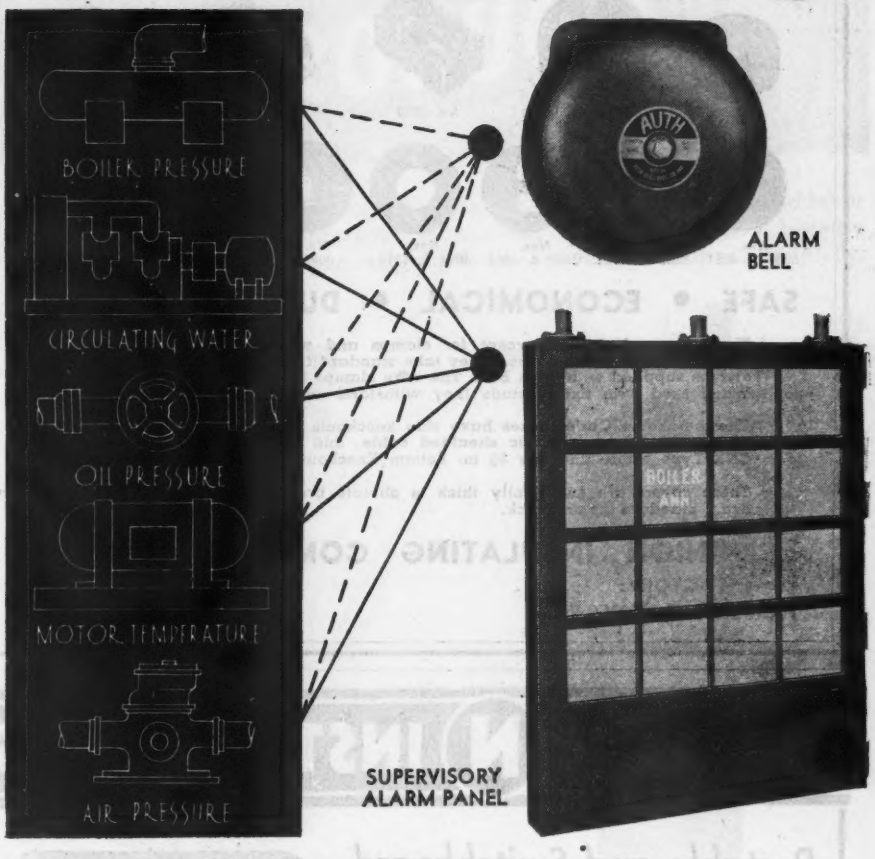
3. The design and operator control of a machine tool can be greatly simplified by applying the V-S Drive.

Possible postwar uses predicted by Mr. Hough include: built in drives on lathes, boring mills, thread grinders and other machine tools; alternating current systems on ships (now being considered) with spot conversion equipment for specific d-c applications such as winch motors.

While discussing the electronic type equipment—conversion affected through electronic tubes—Mr. Hough revealed one marked advantage over the motor-generator type. That is: Less speed drop

AUTH SIGNALS
for INDUSTRIAL MAINTENANCE

AUTH



THE BEST DEFENSE . . .

is often offense. Don't wait for trouble to develop on costly and critical plant equipment — *stop it before it strikes.*

Auth Supervisory Alarm Panels operate in direct connection with pressure switches, temperature switches, float switches, auxiliary circuit breaker contacts, etc. They are designed to indicate both visually and audibly the existence and location of abnormal conditions such as oil temperature changes, overheated bearings, increased or decreased pressure, opening of circuit breakers, high or low tank levels, etc. The audible signal shouts a warning — the panel shows at a glance where the trouble lies — *before, not after, the damage is done.*

Auth Supervisory Alarm Panels are custom built to suit specific requirements. All types and models are available. Our engineers will advise you and supply typical drawings upon receipt of details.

USE AUTH SIGNALS FOR ALL SIGNALING PURPOSES

AUTH ELECTRICAL SPECIALTY CO., Inc.
422 E. 53rd St., New York 22, N. Y.
Offices in principal cities

A Complete Line of

BAKELITE

OUTLET BOXES and COVERS

THAT MEET THE NATIONAL ELECTRICAL CODE AND APPROVED BY FEDERAL HOUSING ADMINISTRATION

BOXES FURNISHED WITH OR WITHOUT CLAMPS

No. 3050 No. 4050 No. 5050 No. 6050 No. 7050

Nos. 3051 & 4051 Nos. 3052 & 4052 Nos. 3053 & 4053 Nos. 3054 & 4054 No. 4055 Nos. 3057 & 4057 Nos. 3056 & 4056

SAFE • ECONOMICAL • DURABLE • NEAT

The sizes and design, except for clamps and wire knockouts, same as standard metal outlet boxes. They take standard type of fixture studs. Two clamps supplied with each box. The wire clamps hold against 125 lbs. pull. When used with fixture studs they withstand over 400 lbs. pull on stud.

These Bakelite Outlet Boxes have side knockouts and clamps to take 14-2, 14-3, and 12-2 non-metallic sheathed cable, and 14-2, 14-3, 12-2 and 12-3 CNX Type Cable and one ½ in. Bottom Knockout.

These covers are sufficiently thick to obviate breakage in installation or use. Standard color Black.

UNION INSULATING COMPANY, INC.

FACTORY: PARKERSBURG, W. VA.

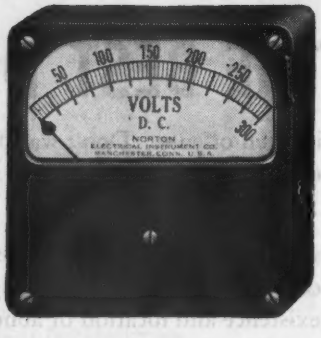
SALES OFFICE: 27 PARK PLACE, N.Y.C.

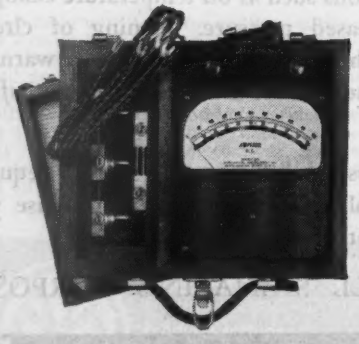
NORTON (N) INSTRUMENTS

Portable and Switchboard

AMMETERS—VOLTMETERS

The scales of Norton Instruments are hand drawn and hand calibrated to meet your special requirements, thus assuring accuracy at every reading point.





Furnished for both switchboard and portable use. Magnetically shielded. Hardened, specially ground pivots, supported by sapphire jewels.

Norton has served the industrial and electrical fields for fifty years. Wherever accurate measurement of electrical units is called for, there is a Norton Instrument to meet the requirements.

Send for our new catalog

NORTON Electrical Instrument Co.

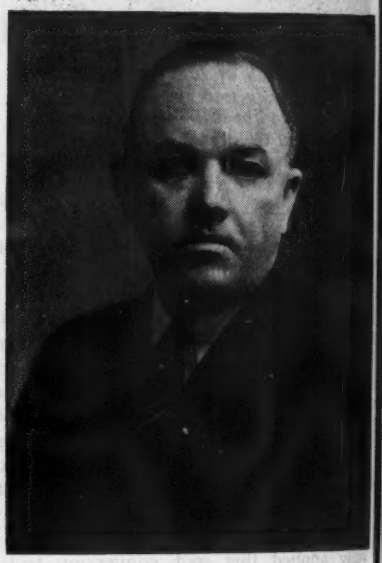
51 HILLIARD STREET • MANCHESTER, CONNECTICUT

between no-load and full-load on the d-c motor. However, the electronic system has no regenerative braking and the dynamic type must be applied.

Concluding his discussion, Mr. Hough predicted increased use of the electronic equipment (at present more expensive) but not to the extent that it will replace the standard rotating type now on the market.

EARL N. PEAK

Earl N. Peak of Marshalltown, Iowa, died January 31st following a two week's illness. Mr. Peak was president of the Marshall Electric Co., Inc., electrical contracting firm and the Rural Development Corporation—a firm engaged in high line construction in rural areas. He was also owner and operator of radio station KFJB at Marshalltown. From 1935 to



EARL N. PEAK

1939, he was president of the National Electrical Contractors Association. During his career in the electrical industry, he was prominent in rural electrification activities and at the time of his death was interested in the prefabricated house field.

Surviving are his wife, one daughter Catherine, and two sons: Wayne—a captain in the U. S. Army; and Eugene—manager of the radio station. It is believed that Eugene will take over his father's electrical business activities.

MILWAUKEE HOLDS INDUSTRIAL SHOW

The Electrical Maintenance Engineers of Milwaukee again provided an excellent opportunity for industrial electrical men, contractors and electricians to secure first-hand information on latest electrical equipment developments when they held their Sixth Annual Industrial Electrical Exposition in the Public Service Building Auditorium, Milwaukee. The ex-

CARBON BRUSH PROBLEMS are discussed at recent Industrial Electrical Exposition in Milwaukee by (L to R) Karl Bartel, Helwig Co.; R. E. Lombard, Milwaukee Sewerage Commission and treasurer of Milwaukee Electrical Maintenance Engineers and H. M. Eversz, B-W Superchargers, Inc., and president of the E.M.E. group.

hibit was open the evening of Feb. 1 and the afternoon and evening of Feb. 2.

More than 1,000 registrants from surrounding industrial plants and electrical establishments took advantage of the show to closely inspect the exhibits of some 43 electrical equipment manufacturers and distributors; to ask questions; pose problems and get answers. Result—many specific problems that could have been answered only by a personal visit of a manufacturers' representative were solved on the spot, saving considerable time of both interested parties.

The exhibits were not spectacular from the standpoint of new equipment. Manufacturers are still neck-deep in war production. There were, however, many refinements in existing products. Exhibits included the general run of construction materials—wire, cables, connectors, conduit fittings and accessories, bus duct, etc.; operating equipment—switches, controls (electronic and mechanical), circuit breakers, panel cubicles, transformers, motors, electric heaters, etc.; maintenance equipment—fuses and accessories, instruments, carbon brushes, insulating materials, and many other interesting items; lighting equipment—high intensity incandescent and mercury vapor units, commercial and industrial fluorescent units (standard, vaporproof, and explosion-proof) with a variety of new maintenance features. Many of those present saw the new "slimline" fluorescent lamp for the first time.

One exhibit that attracted considerable attention was the G.E. demonstration of the recently developed magnetic wire recorder—a device that replaces wax disks and cylinders; another, the Allis-Chalmers exhibit of an electronic device, the details of which are still enshrouded in military secrecy.

Among the exhibitors were six local motor service shops—Clark Electric Service, Dietz Electric Co., General Electric Service Shop, Holt Electric Motor Co., Trester Service Electric Co., and Westinghouse Electric Service Shop.

Exhibitors and registrants alike were generous in their praise of the successful exposition which ended with the Annual Dinner Dance of the E.M.E.

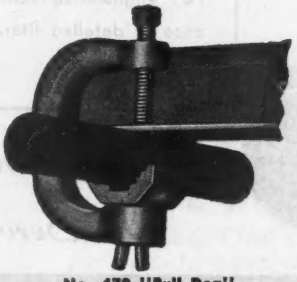
LATROBE

FLOOR BOXES

WIRING SPECIALTIES

PRODUCTS

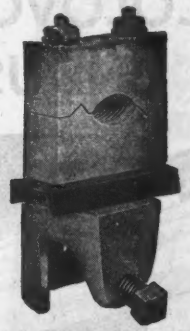
Latrobe Products are easily and quickly installed. They are time-savers and labor savers—Factors of vital importance today—and of sound economy because Latrobe products can be depended upon to stay on the job long and faithfully.



No. 470 "Bull Dog"
Pipe or conduit Hanger
Right for hanging ½", ¾" and 1" pipe or conduit to steel beams up to ⅜" thick. May be used also as ground clamp.

No. 480 "Bull Dog"
Armored Cable Support
For installing Armored Cable in factories or other buildings of steel construction. Permits cable to run at any angle.

No. 130 Floor Box
Shown with No. 207 Bell Nozzle.
Cutaway illustrates how Tapered Unit Receptacle fits Tapered Opening in adjusting ring.



"B & D" Cleat Attached
To "Bull Dog" Insulator Support
Cleat attachment consists of cross bar with necessary bolts and screws for attaching.

No. 280 Nozzle With
No. 200 Cover Plate
Ten Amp. 250 Volt receptacle in brass housing, ½ in. brass pipe extension.

BX Staples
These high quality staples are supplied in units of cartons, kegs and barrels.

QUALITY ALWAYS

FULLMAN MANUFACTURING CO.
LATROBE, PA.

ELECTRICITY
For Any Job—Anywhere

Reliable, economical electric service for electrical contracting projects anywhere, anytime, with an Onan Electric Generating Plant. From the 65 basic models, the right plant for any job or application, large or small, can be selected.
Driven by Onan built, 4-cycle gasoline engines, these power plants are of single-unit, compact design and sturdy construction. Suitable for all mobile, stationary or emergency service.

Model shown is from W2C series, 2 and 3-KW, 60-cycle, 115 volt; powered by water-cooled, 2-cylinder engine.

ELECTRIC PLANTS Onan

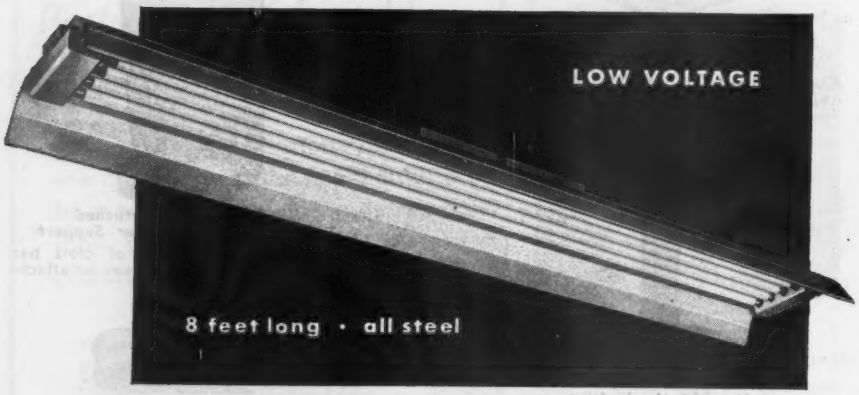
Models range from 350 to 35,000 watts. A. C. types from 115 to 660 volts; 50, 60, 180 cycles, single or three-phase; 400, 500, and 800 cycle, single phase; also special frequencies. D. C. types range from 6 to 4000 volts. Dual voltage types, available. Write for engineering assistance or detailed literature.

Over 250,000 In Service

D. W. ONAN & SONS

2100 ROYALSTON AVE.
MINNEAPOLIS 5, MINN.

*COLOVOLT COLD CATHODE INDUSTRIAL FIXTURES



Here is the new Colovolt industrial fixture, one of a complete line of industrial and commercial "packaged" units. Equipped with the standard 93" Colovolt 10,000 hour lamp, Colovolt fixtures may be used singly or in continuous line lighting in multiples of 8 feet. Instantaneous starting, no flickering, guaranteed for 1 year except for failure due to breakage are extra advantages of the Colovolt Cold Cathode low voltage fluorescent lamp. The long life expectancy of Colovolt lamps may be realized even when constantly turned on and off, and *pre-scheduled re-lamping, with no loss of production or time, is now possible with Colovolt installations.*

**Trade mark registered U. S. Pat. Off.*

Contact your electrical wholesaler or jobber, or write us for full details and prices.

General LUMINESCENT CORPORATION

GENERAL LUMINESCENT CORPORATION
672 S. FEDERAL STREET CHICAGO 5, ILLINOIS

NEW CHAIRMAN of the Illinois Chapter, IAEI, L. E. Ewald, Commonwealth Edison Company, Chicago, accepts the gavel from retiring chairman, N. Mosser, city electrical inspection department, Chicago.

SAN FRANCISCO CONTRACTORS ELECTS OFFICERS

After serving four years as president of the San Francisco Electrical Contractors Assn., Inc., George W. Abbett, although urged to continue, relinquished the presidency to James M. Galvin, Galvin Brothers Electric Co., at the annual election of officers in January. Galvin was vice-president last year. Thomas Harris, H. S. Tittle Co., was elected vice-president and Edward W. Scott and George D. Smith were re-elected respectively to the posts of secretary and treasurer. On the board of directors are George W. Abbett; H. C. Reid; P. Furlong, Century Electric Co.; C. L. Chamblin, California Electric Construction Co.; Everett Carlson, Central Electric Co.; K. M. Ryals, Stone-Ryals Co. and B. J. Doherty. The San Francisco association also voted to ask the Northern California Chapter, National Electrical Contractors Assn., to relinquish the territory of San Francisco, Marin and San Mateo Counties to it in order that it might apply for a chapter charter.

INTERNATIONAL LIGHTING EXPOSITION POSTPONED

Postponement of the International Lighting Exposition scheduled for Chicago on April 19-23 until next year was announced by the chairman of the Industrial and Commercial Lighting Equipment Section of the National Electrical Manufacturers Assn., S. R. Naysmith. This action resulted from the desire of the Association to co-operate fully with the expressed desire of the government to reduce travel resulting from conventions and expositions.

The Section released the following statement: "While lighting is essential to effective war production and while every exhibitor in the now postponed Exposition is engaged in vital war production, it is the conviction of the members of the Industrial and Commercial Lighting Equip-

ment Section of the National Electrical Manufacturers Association that in view of the expressed desires of War Mobilization Director Byrnes, the International Lighting Exposition planned for April of this year should be postponed.

"Naturally, the Section regrets that such action has became necessary. The interest in the Exposition has been so great that it is evident that a lighting exposition can and will serve a great public purpose. It is the aim of the Industrial and Commercial Lighting Equipment Section to continue with the plans of this Exposition to the end that when we are closer to Victory the Exposition can be held with special emphasis on lighting for the reconversion and post-war periods. The Section expresses its thanks to all those who have co-operated so fully in the Exposition activity and asks their continued support during the interim activities. Any correspondence relatve to the Exposition should be addressed to the Secretary, Industrial and Commercial Lighting Equipment Section, National Electrical Manufacturers Association. 155 East 44th Street, New York 17, New York.

TOGESEN HEADS DETROIT GROUP

A. A. Togeson, Bull Dog Electric Products Co., Detroit, was re-elected president of the Electrical Association of Detroit for 1945. Other officers elected include: vice-president, H. J. Hall, Detroit Edison Co.; secretary, J. S. Ecclestone, S. P. Ecclestone & Sons, Inc.; treasurer, C. C. Munroe, Detroit Edison Company. C. G. Odell, was reappointed executive secretary.

The new Board of Governors includes the following electrical industry representatives: Andrew Rogerson—contractors; Victor Wagner—architectural, design and research engineers; John Stewart—commercial and industrial maintenance engineers; A. A. Togesen—manufacturers; J. S. Ecclestone—manufacturers agents; H. I. McConnell—wholesalers; G. W. Krauel—utilities; J. P. Davenport and H. P. Haggerty—electronic and radio specialists.

NEWSTONE APPOINTED TO STATE BOARD

Sam Newstone, electrical contractor and dealer of Montevideo has been appointed by Governor Edward Thye of Minnesota as a member of the State Board of Electricity to succeed the late Edward J. Micka of Hibbing.

Mr. Newstone has been in the electrical business in Montevideo for the past 29 years; is a veteran of World War I; as a past president of the Minnesota Electrical Council and has served as a director of that group for the past 12 years. He is chairman of the Local Selective Service Board and a member of the Chippewa County Commissioners.

Jack of all PARTS CLEANING Methods and MASTER OF EACH

Circo Chief DEGREASER

The new Circo "Chief" twin-tank degreaser packs more punch, speed, production, thoroughness and versatility in parts cleaning than any cleaning unit on the market bar none. All of this adds up to lower cleaning costs, higher production and far more satisfactory results. No installation costs, you merely hook into electric line.

The operator has at his finger tips four different cleaning methods—hot vapor cleaning (automatic), spraying (automatic), soaking, or dipping, any one of which requires no more effort than putting basket of parts in degreaser. The choice of methods depends on the condition of parts, however, it will clean any and all types of metal separately or all at the same time without any harmful effects. Circo "Chief" is a real two-fisted bulldozer when it comes to tough, dirty, greasy parts, as the clean hot vapor thoroughly cleans and dries them in a matter of three to four minutes. To spray parts, trip foot pedal, which operates pump and immediately a constant pressure stream of solvent sprays and cleans parts.

Wire basket is equipped with unique handles, enabling operator to hook them over sides of tank for hot vapor cleaning, spraying, soaking, or dipping.

Circo "Chief" is loaded with exclusive "built-in" engineering features, each highly important, each one demonstrative, yet it is simplicity personified in design and operation.

HERE IS Versatility IN CLEANING PARTS

Spraying

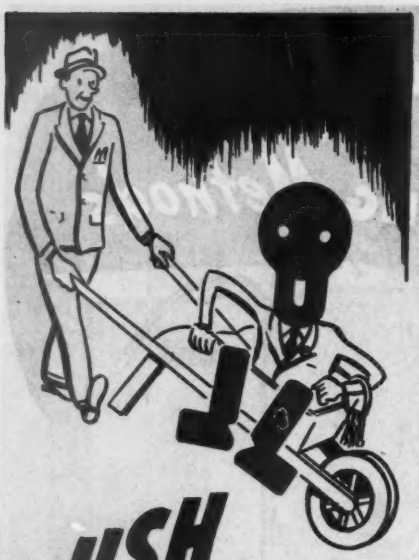
Soaking

Vapor Cleaning

Dipping

Send for New Free Bulletin

CIRCO PRODUCTS COMPANY
2835 CHESTER AVE. • CLEVELAND 14, OHIO



PUSH

FLUR-O-LOCKS

SAFE, ECONOMICAL
for Protection of
EMPLOYEES AND MACHINERY

FLUR-O-LOCKS are the new, patented safety locks for fluorescent lamps that tend to increased efficiency of lamp, starter, and ballast — are economical and easy to install. Recommend FLUR-O-LOCKS as a protective measure against lamps falling due to vibration and improper installation.

FLUR-O-LOCKS are at present standard equipment in more than 5,000 leading industrials. Sold and warehoused by General Electric, Westinghouse, Graybar Electric, supply houses and other distributors.

Write for Free Folders and Samples

FLUR-O-LOCKS are economical and as easy to install as illustrated in the diagram.

Illustration of two fiber parts of FLUR-O-LOCKS—perforated disc and key—as applied to fixture and adjusted for locking.

Flur-o-locks by
LADUBY COMPANY

Other reappointments to the State Board of Electricity submitted by Governor Thye to the Senate include: George R. Jones, Industrial Electric Co., Minneapolis, who has completed 16 years of service on the board; R. C. Condon, superintendent of municipal utilities, Shakopee, who completed his first five-year term; J. C. Montgomery, City Engineering Department, Minneapolis, with a partial and a full five year term to his credit; and William F. Boland, a veteran of 20 years of service on the board, who is employed at the Ramsey County Court House.

REVISIONS IN HANDBOOK OF INTERIOR WIRING DESIGN BEING STUDIED

The Technical Subcommittee of the Industry Committee on Interior Wiring Design met in New York recently for the purpose of reviewing several sections of the revised draft of the Handbook of Interior Wiring Design. The draft under review consists of two sections, one on Residential Wiring Design and the other on Farmstead Wiring Design.

The Residential Wiring Design draft in its present form appears somewhat simplified from the original issue. The draft on the Farmstead Section had been sent nationwide, prior to the meeting of the Technical Subcommittee, to a number of members of the American Society of Agricultural Engineers in the educational, commercial and governmental fields interested in rural electrification and in farm structures; and also to others outside of the society who had similar interests. Over ninety individuals and groups received a copy with the request that they comment on the material, thus giving the committee the benefit of their experience and advice. Seventy-three percent responded with, in many cases, most constructive comments, and, in some cases outright approval. The subcommittee reviewed all the comments submitted, giving careful consideration to each one.

Both sections of the Handbook are now in the process of being redrafted in line with the action taken by the Technical Subcommittee at its meetings. The revised draft was submitted in January to each member of the Technical Subcommittee for final approval.

Upon completion of the Farmstead and Residence Wiring Standards, work will commence on revising the wiring standards for multi-family dwellings and for commercial, public and industrial occupancies.

The Technical Subcommittee consists of A. Carl Bredahl, Chairman, Westinghouse Electric and Manufacturing Company; Arthur Abbott, NEMA; Leo Dolkart, Leonard Construction Company; H. G. Knoderer, General Electric Company; Morris H. Lloyd, Niagara, Lockport and Ontario Power Company; George McKee, George H. McKee Company, Inc.; H. R. Stevenson, Detroit Edison Company; C. P. Wagner, Northern States Power Company; and C. A. Ward, Electric Bureau of Paterson, N. J.

CMP REG. NO. 9 SUSPENDED AND CMP-9A AMENDED

Because of the critical need of the armed forces for a sharply-increased supply of field wire, the War Production Board has announced the suspension of Controlled Materials Plan Regulation No. 9 and amendment of CMP-9A. CMP-9 is the regulation that permitted retail stores to purchase copper wire for sale to civilians and CMP-9A provides copper wire for use by civilian repair shops. Industrial procurement under CMP-9A is not affected.

In accordance with the suspension provisions affecting CMP-9, retailers must immediately cancel all outstanding orders for copper wire on which they used the allotment symbol V-3. Producers and warehouses are also prohibited from filling V-3 copper orders if they have reason to believe the order was placed by a retailer pursuant to CMP-9.

Suspension of the regulation does not affect the sales of copper wire under Direction 21 to CMP-1, which provides for the farmers' copper wire allotment certificate.

The limits on the repairman's purchase of copper wire under CMP-9A were reduced by the February 15th amendment to $75 worth of wire per calendar quarter or 10 percent of what the repairman used in 1941, whichever is higher. The former limits under CMP-9A were $150 or one-eighth of his 1941 production, whichever was higher. However, the amendment provides that the alternative choice of the 10 percent base will not be allowed unless the repairman produces definite records.

In addition to limiting the copper wire that repair shops may obtain, the amendment prohibits use of materials for certain kinds of work. Failure to comply would make the repair shop liable to withdrawal of all WPB priorities assistance in obtaining materials. The prohibited uses are:

1. No new connecting or attachment cord may be supplied for a vacuum cleaner, washer, refrigerator, iron, radio, lamp, fixture, or any other electrical appliance or piece of equipment where it is possible, by patching or by the use of insulating tape, to put the old cord in condition for reasonably good service for the remainder of 1945.

2. No wire may be used to assemble or make up a new connecting or extension cord, for resale or gift purposes, or to accompany or be used with any appliance or piece of equipment being repaired or sold. Other provisions are made by the War Production Board for the manufacture of appliance and extension cords.

3. No new wiring of any kind may be installed in any building except to the extent permitted by Direction 2 to this regulation. If wiring is in fact damaged, it may be replaced, but only the minimum amount necessary to make the repair may be used.

4. The conversion of a vase or other object into a lamp is the manufacture of a lamp and not repair. The use of copper wire in such manufacturing is prohibited by Conservation Order M-8-c.

CALDWELL LEAVES UNDERWRITERS

Benjamin P. Caldwell, Jr., recently resigned as assistant secretary and public relations director of Underwriters' Laboratories, Inc., Chicago, to accept a position with N. W. Ayer & Son, Chicago advertising agency. Mr. Caldwell, associated with the Laboratories for 14 years, has been active in IAEI activities, having addressed numerous Section and Chapter meetings in the past.

SHEBOYGAN INSPECTOR RESIGNS

E. W. Vollbrecht, chairman of the Wisconsin Chapter, IAEI, recently resigned as electrical inspector of Sheboygan, Wis., a position he has held since his appointment in 1935. His appointed successor is Eugene Roth, former deputy electrical inspector of Sheboygan.

BENTLEY HEADS NISA GROUP IN WISCONSIN

William J. Bentley, Bentley Electric Co., Milwaukee, was elected president of the Wisconsin Chapter, NISA, at the annual meeting of that group. Other officers, all of Milwaukee, elected for the 1945 term include: first vice-president, F. J. Roehrer, Dietz Electric Co.; second vice-president, George Van Domlen, Quality Electric Service Co.; secretary-treasurer, Roy Schulz, Al Schulz & Son Electric Company.

DATES AHEAD

Utah Chapter, IAEI—Monthly meeting, Auditorium, Utah Power & Light Co., Salt Lake City, Utah, March 6.

George Washington Chapter, IAEI—Monthly meeting, District Building, Washington, D. C., March 12.

Rocky Mountain Chapter, IAEI—Monthly meeting, Rm. 385, City and County Bldg., Denver, Colo., March 13.

Chicago Technical Societies Council—Third Annual War Production Conference, Hotel Stevens, Chicago, Ill., March. 29.

Utah Chapter, IAEI—Monthly meeting, Auditorium, Utah Power & Light Co., Salt Lake City, Utah, April 3.

George Washington Chapter, IAEI—Monthly meeting, District Building, Washington, D. C., April 9.

Midwest Power Conference — Palmer House, Chicago, Ill., April 9-10.

Rocky Mountain Chapter, IAEI—Monthly meeting, Rm. 385, City and County Building, Denver, Colo., April 10.

National Industrial Service Association—Annual conference, LaSalle Hotel, Chicago, April 16-18.

National Fire Protection Association—Annual meeting, Palmer House, Chicago, Ill., May 7-11.

Rocky Mountain Chapter, IAEI—Monthly meeting, Rm. 385, City and County Building, Denver, Colo., May 8.

Electrical Committee, N.F.P.A.—Edgewater Beach Hotel, Chicago, Ill., Week of May 14.

Utah Chapter, IAEI—Monthly meeting, Auditorium, Utah Power & Light Co., Salt Lake City, Utah, June 5.

George Washington Chapter, IAEI—Monthly meeting, District Building, Washington, D. C., June 11.

Rocky Mountain Chapter, IAEI—Monthly meeting, Rm. 385, City and County Building, Denver, Colo., June 12.

ZINC COATED
HOT-DIPPED GALVANIZED

The best protective coating for steel is pure zinc and the best method of applying the zinc is by hot dipping

●

G-E White Rigid Conduit gives permanent protection to wiring. G-E White is heavily coated inside and outside by immersion in molten zinc—the hot dipped galvanizing method. This method provides the most durable coating of pure zinc that can be applied by any process. In addition, G-E White has a coating of baked Glyptal inside and out.

G-E White Rigid Conduit is easy to install. It has accurate threads. Its smooth interior surface aids wire pulling. It can be used in the severest locations. It is resistant to heat, flame, cold, moisture, gas, alkalies and mechanical injury.

FOR FURTHER INFORMATION see the nearest G-E Merchandise Distributor or write to Section C351-8, Appliance and Merchandise Department, General Electric Co., Bridgeport, Connecticut.

BUY WAR BONDS AND HOLD THEM

GENERAL ELECTRIC

BADGER

Synchronous Automatic **TIME SWITCHES**

for

ACCURATE TIMING

•

ECONOMICAL OPERATION

•

YEARS OF GOOD SERVICE

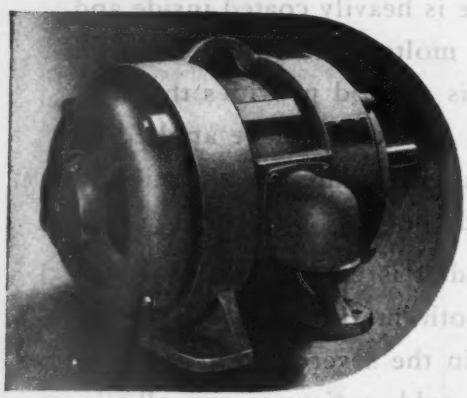
•

● *Prompt delivery on orders rated AA-5 or Higher.*

Type	Poles	Switch Capacity	Case
M1 (Synchronous)	1	50 A. at 125 V.	16 Ga. Steel
M2 "	2	50 A. at 125/250 V.	16 Ga. Steel
RM "	1	50 A. at 125 V.	Cast Iron
RM5 "	2	50 A. at 125/250 V.	Cast Iron

RELIANCE AUTOMATIC LIGHTING CO. RACINE WISCONSIN

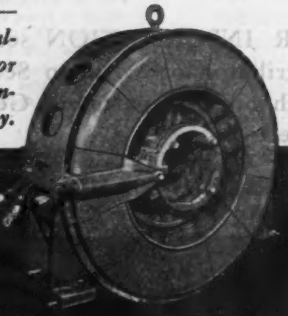
BURKE *Induction* MOTORS



Investigate Burke's line of Induction Motors for application from 1 to 1500 H.P. All welded frames, no rivets or bolts—air gap held to very close limits—all coils are form wound and treated with plastic, age-resisting composition, vacuum impregnated. Individual coils easily replaced — a modern sturdy design.

Burke Motors available in all forms and types. Multi-speed — drip and splash proof — enclosed fan cooled — vertical-flange—round frame—elevator —crane and hoist, etc. for continuous and short time duty.

WRITE FOR BULLETIN 101-A



● BURKE ELECTRIC CO.
● ERIE PA., U.S.A.
AC & DC GENERATORS · EXCITERS · ·
AC & DC MOTORS · TERMINAL BLOCKS
MOTOR GENERATOR SETS

Utah Chapter, IAEI—Monthly meeting, Auditorium, Utah Power & Light Co., Salt Lake City, Utah, May 1.
George Washington Chapter, IAEI—Monthly meeting, District Building, Washington, D. C., May 14.
American Institute of Electrical Engineers—Summer Technical Meeting, Hotel Statler, Detroit, Mich., June 25-29.
National Electrical Contractors Association—Annual conference, Grand Hotel, Mackinac Island, Mich., Sept. 9-15.
International Municipal Signal Association, Inc.—Annual meeting, Hotel La Salle, Chicago, Ill. September 24-27.

CANCELLED OR POSTPONED

National Electrical Manufacturers Assn.—Spring Conference, Palmer House, Chicago, Ill., April 16-19.
International Lighting Exposition—Palmer House, Chicago, Ill., April 19-23.
National Electrical Wholesalers Assn.—Spring meeting, April 23-25.

MANUFACTURERS NEWS

WESTINGHOUSE CHANGES

Thomas I. Lane has been appointed assistant to the Central District manager of the Westinghouse Electric and Manufacturing Company. From 1915 to 1925 he was with the Automotive Division, first in the New York office and then going to Buffalo as office supervisor in 1927. In his new position he returns to Pittsburgh.

E. W. Hoffman has been named Central district order supervisor and acting stock supervisor and A. B. McKelvy as a staff assistant.

Establishment of a New England District of the Westinghouse Lamp Division's field organization and appointment of George H. MacGilvray as district manager has been announced. New warehouse facilities have been taken over at 145 Ipswich Street, Boston. Mr. MacGilvray will continue to supervise customer relations in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut from his former headquarters at 10 High Street, Boston.

G-E APPOINTMENTS

Philip D. Reed, who until recently was chief of the American Mission for Economic Affairs in London with rank of minister, was re-elected a director and chairman of the board of the General Electric Company, a position from which he resigned in January, 1943. In addition he was elected chairman of the board of the International General Electric, a position formerly held by Gerard Swope.

Ralph J. Cordiner has been elected vice president and assistant to the president. Mr. Cordiner has been assistant to the president for the past 18 months, since his resignation as vice chairman of the War Production Board.

P. D. REED

R. J. CORDINER

Lawrence Jennings, regional supervisor of G-E appliance sales to central stations since 1938, has been named assistant to E. O. Shreve, vice president in charge of customer relations. Mr. Jennings will maintain headquarters in New York.

To coordinate General Electric's widely diversified interests and afford better service to the company's wartime customers, both military and those industries manufacturing war materials, 10 commercial vice presidents, representative of every sales district of the company in the United States, will relinquish their responsibilities for apparatus sales and become members of the President's staff, it was announced recently by Charles E. Wilson, president. In their new positions these men will report to E. O. Shreve. Those affected by the change are: R. M. Alvord, San Francisco; T. F. Barton, New York; W. O. Batchelder, Chicago; L. T. Blaisdell, Cleveland; W. B. Clayton, Dallas; E. H. Ginn, Atlanta; A. L. Jones, Denver; T. S. Knight, Boston; A. S. Moody, Portland, Ore.; and C. K. West of Philadelphia.

Simultaneously Chester H. Lang, vice president and apparatus sales manager, announced new district managers of apparatus sales to take over the duties formerly handled by these commercial vice presidents. They are: C. E. H. Palmer, of New Haven, the New England district with headquarters in Boston; W. J. Dorworth, of Philadelphia, the Atlantic district; C. L. Redd, of Birmingham, the Southeastern district with headquarters in Atlanta; C. W. Fick, of Cleveland, the East Central district; R. I. Parker, of Chicago, the Central district;

HOW TO PREVENT POWER FAILURES

THIS SAFER PROTECTION FOR POWER CIRCUITS KEEPS YOUR PRODUCTION UP TO SCHEDULE

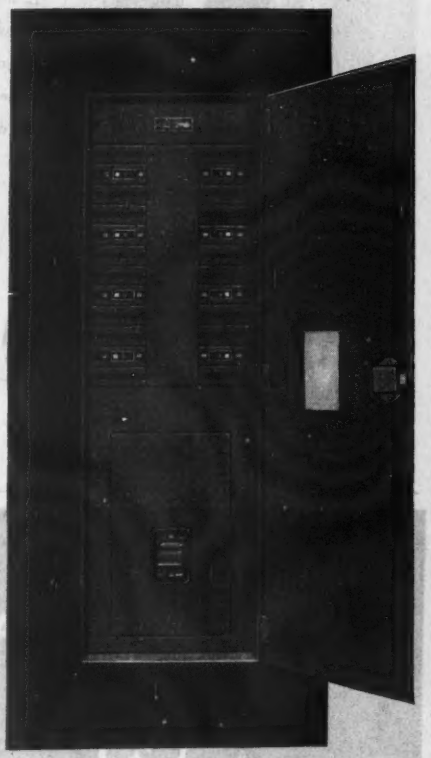
Now you can get rid of power-failure worries for good and make sure of keeping every machine and operation in your plant running on schedule by specifying Kinney "Nofuze" Circuit Breaker Panels for your power distribution system.

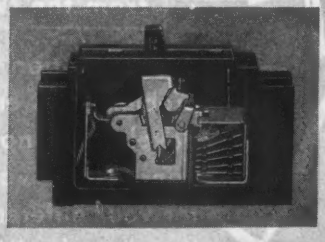
These panels give greater freedom from work stoppages because their patented "Nofuze" circuit breakers are not affected by momentary overloads that constantly occur when machines are operated at peak capacity in 24-hour-a-day war production. In fact, the inverse-time characteristic of the breakers in Kinney "Nofuze" Power Panels actually resist tripping on harmless overloads, yet trip faster and more positively on dead shorts or overloads which are dangerously prolonged.

Here is unfailing *double protection* for your plant's vital power distribution system. You are protected *first* against annoying production delays resulting from minor overloads, and you are protected *secondly* against costly shutdowns resulting from major damage to your system from shorts or serious overloads.

Act now to assure your plant of this double protection with Kinney "Nofuze" Power Panels, available in both Narrow Distribution and Convertible Distribution types.

The Kinney line also includes "Nofuze", "Uni-Breaker" and "Quicklag" circuit breaker lighting panels; Switch-and-Fuse Panels and Switchboards.





INTERIOR VIEW OF "NOFUZE" BREAKER

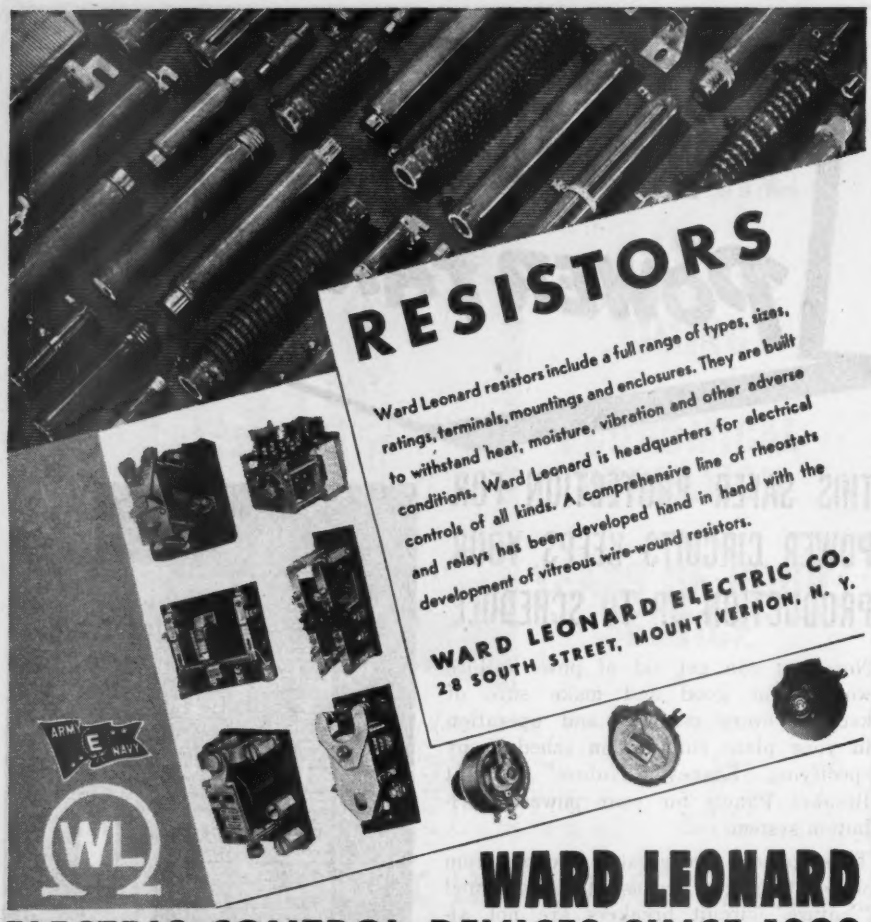
Kinney "Nofuze" Power Panels Give You These Superiorities

- Thermal-element breakers have inverse-time characteristic
- Breakers feature deionizing principle arc quench
- Full time delay on harmless overloads
- Quick tripping on dead shorts
- Listed by Underwriters' Laboratories

KINNEY

PANELBOARDS SWITCHBOARDS

KINNEY ELECTRICAL MFG. COMPANY • 2900 CARROLL AVENUE • CHICAGO 12, ILLINOIS


RESISTORS
Ward Leonard resistors include a full range of types, sizes, ratings, terminals, mountings and enclosures. They are built to withstand heat, moisture, vibration and other adverse conditions. Ward Leonard is headquarters for electrical controls of all kinds. A comprehensive line of rheostats and relays has been developed hand in hand with the development of vitreous wire-wound resistors.
WARD LEONARD ELECTRIC CO.
28 SOUTH STREET, MOUNT VERNON, N. Y.
ARMY E NAVY
WL
WARD LEONARD
ELECTRIC CONTROL DEVICES SINCE 1892

THE IWI MAN
WITH A WISE PLAN carries
ESSEX
MAGNET
WIRE
Saves hours and steps... buy from the IWI Blue Catalog
IWI CATALOG
Specialization in magnet wire problems has enabled ESSEX to develop economical, easy-to-handle and varied wire types for your different needs. They're listed in the IWI Blue Catalog.
INSULATION AND WIRES
SERVICE
INSULATION & WIRES, INC.
2127 PINE STREET • ST. LOUIS, MO.

H. A. White, of Dallas, the Southwestern district; F. H. Doremus, of Denver, the Rocky Mountain district; A. G. Jones, of San Francisco, the Pacific district; and J. R. Murphy, of Spokane, the Northwestern district, with headquarters in Portland, T. F. Barton, of New York, will continue for the present to act as the New York district manager in addition to his new duties on the President's staff.

Roy N. Fowler has been appointed Southeastern District manager of the Electronics Department, with headquarters in Atlanta. He replaces Claude Hendon, recently made manager of sales of the Tube Division, with headquarters at Schenectady. Mr. Fowler formerly was electronics district manager in Dallas.

T. B. Willard has been made Southwestern District manager of the Electronics Department, with headquarters in Dallas. He formerly was a district representative for the department at Atlanta.

L. R. O'Brien and R. W. Metzner, former executives in the Ken-Rad Tube and Lamp Corporation, have been appointed sales managers in the Tube Division of the Electronics Department.

RCA APPOINTMENTS

Charles W. Taylor has been named manager of RCA Tube Parts and Machinery Sales. Mr. Taylor will be located at the company's Harrison, N. J. plant where he will work under the direction of L. S. Thees, manager of RCA's equipment tube section.

John W. Kirschner has been named sales representative for the east in the Equipment Sales Section of the Radio Corporation of America.

OKONITE APPOINTMENTS

A. L. McNeill has been appointed manager of the Chicago District of the Okonite Company and will direct the insulated wire and cable sales in the middle Western territory extending from Ohio to the Rocky Mountains.

E. H. McNeill, formerly manager of the Power and Light Department has been appointed assistant manager, Chicago District and Harry D. Pierce has been made office sales manager.

FIGERGLAS CORP. PERSONNEL CHANGES

Changes in the branch personnel of Owens-Corning Fiberglas Corporation have been announced by W. P. Zimmerman, vice president.

Ben S. Wright, since November, 1940, manager of the Fiberglas Fabrics Division in the Toledo general offices, has been transferred to Cleveland as manager.

Mr. Wright succeeds W. H. Atkinson, who becomes manager of the Chicago branch office. Mr. Atkinson has been affiliated with Fiberglas since November 1938. He succeeds Frank L. Myers, who has been the Chicago branch office manager since November 1938. He will return to the company's general offices to join the general sales organization. In his new post, Mr. Myers will be on the staff of J. H. Thomas, general sales manager.

Earl Swaim, formerly Buffalo branch manager, will return to the Toledo general office. Mr. Swaim is associated with G. E. Gregory, vice president in charge of commercial development.

AMERICAN STEEL & WIRE PROMOTIONS

Allen Robinson has been appointed head electrical engineer of American Steel & Wire Co., and Clare L. Becker has been named assistant electrical engineer. Both men will be located in the Cleveland office.

Albert W. Nelson has been named assistant manager of sales for the New England district, with headquarters in Boston.

SYLVANIA ANNOUNCEMENTS

The opening of another new Sylvania plant, located in Jamestown, N. Y. has been announced by H. W. Zimmer, general manager of operations, Radio Division of Sylvania Electric Products, Inc. This plant will be under the management of George B. Erskine, plant manager of all radio parts plants, with Rolf D. Ripley as resident supervisor.

Howard J. Martin has been appointed Division sales manager of the Mid-Eastern Division of Sylvania. Mr. Martin was formerly associated with the Tri-Electric Company, United Light and Power Company and Curtis Lighting, Inc., of Manhattan, Kansas.

WESTINGHOUSE SUPPLY APPOINTMENTS

The appointment of Robert E. Burrows as manager of General Radio Sales, with offices in New York City, has been announced by the Westinghouse Electric Supply Company.

Robert P. Smith has been appointed General Farm Sales manager, with offices in New York. Mr. Smith returned to Westinghouse after being on a leave of absence with the War Production Board in Washington.

Earl W. McBratney was named district sales promotion manager and Arthur F. Sheean was made district lamp man-

Read...

THE JAEGER SPEED INDICATOR

at your convenience

This compact watch-like speed indicator holds the reading in rpm after disengagement from the rotating part, thereby eliminating the necessity of reading the instrument while in operation. It consists of a non-magnetic watch movement combined with a simple revolution counter to time the revolutions of the unit under test for a period of six seconds. The hands stop automatically at the points indicating the average speed during the time interval of testing, and the indicated reading in rpm may be made when convenient.

The Jaeger Speed Indicator can also be used to measure linear or peripheral speeds by replacing the rubber spindle tip with the rubber-tired pulley supplied with each instrument. The dial readings divided by 2 indicate speed in feet per minute.

Jaeger instruments are supplied in two models—for low speeds up to 2000 rpm in divisions of 1 rpm readable to 0.5 rpm and for high speeds up to 10,000 rpm in divisions of 10 rpm readable to 5.0 rpm. Accuracy is ½ of 1% of dial readings.

Write for Bulletin 1750-EC

Jaeger Speed Indicator in carrying case. Accessories include 2 shapes of rubber spindle tips and one rubber-tired pulley. Case measures 3½" x 4⅞" x 1½". Weight, complete, 11 oz.

JAMES G. BIDDLE CO. • 1211-13 ARCH STREET PHILADELPHIA 7, PA.

PARTS FOR CONTROLS MOTORS FANS

PROMPT SHIPMENT FROM LARGE STOCKS

AUTHORIZED PARTS DISTRIBUTORS

Brown-Brockmeyer
Century
Cutler-Hammer
Delco
Diehl
Duro
Emerson
General Electric
Hamilton-Beach
Holtzer-Cabot
Howell
Hunter
Ilg
Leland
Marathon
Master
Peerless
Robbins & Myers
Star
Thor
Wagner
Westinghouse

READING ELECTRIC COMPANY, INC.

Parts Distributors for the Manufacturer

200 William St. *Barclay 7-6616* **New York 8, N. Y.**

Give Industry SPEEDIER PAGING — with BELL VOICE-PAGING EQUIPMENT

BELL Voice-Paging Equipment locates individuals in the quickest time possible . . . cuts "hold-the-phone" delays to the minimum . . . provides for plant-wide broadcasting of announcements, instructions, time signals and alarms — and also permits plant-wide broadcasting of recorded music! Its widely adjustable, precision-built, standard units — specially designed for industrial use — can be grouped to fit any need. Also designed for quick, easy expansion or rearrangement. Get details on this new BELL Industrial Sound Equipment.

BELL SOUND SYSTEM, Inc.
1196 Essex Ave., Columbus 3, Ohio
Export Office: 4900 Euclid Ave., Cleveland 3, Ohio

ager in the North Pacific District. Both men will have their headquarters in Seattle.

Eric Hall has been appointed New Jersey Division manager, with offices in Newark, N. J.

FARADAY CHANGES

Faraday Electric Corporation will move its executive, sales and advertising offices from Adrian, Mich. to 11 South LaSalle Street, Chicago.

Among those moving to Chicago will be Paul H. Hill, vice president in charge of sales, Joseph E. Fanning, assistant sales manager, Herbert W. Schild, advertising manager, Paul G. Taylor, manager of Merchandise Division, Frederick T. Mayer, manager of Cornice Division and F. E. Howell, manager of Transportation Division.

Robert W. Fishburne has been appointed representative for Faraday. He will cover the state of Virginia and maintain his office at 111 North 8th Street, Richmond.

•

Allis-Chalmers Manufacturing Co. has announced the appointment of U. E. Sandelin as manager of the Seattle, Wash., district office. Mr. Sandelin succeeds A. J. Schmitz, who has been named Pacific regional manager. He also will supervise the Spokane, Wash., branch office.

•

George K. Perley, sales engineer, has joined **Edwards and Company, Incorporated,** of Norwalk, Conn. Mr. Perley will be located at the New York office, 79 Madison Avenue. He was formerly affiliated with the Holtzer-Cabot Electric Company.

•

Sperti, Inc. has announced the opening of a New York office at 714 Fifth Avenue. The headquarters, laboratories and manufacturing plant of Sperti are located in Cincinnati. George Stevens has been named manager of the New York office.

•

The Standard Transformer Company of Warren, Ohio, has appointed the Hoffman Supply, with offices at Albuquerque, New Mexico and Abilene, Texas, as representatives.

•

Union Insulating Company, Inc., has announced the appointment of J. J. Coughlin, Jr. as sales manager covering all of the Metropolitan District, as well as part of New England up to Hartford, Conn.

War Know-How Makes Postwar Jobs

[FROM PAGE 77]

efforts (successfully) to participate in war contracts calling for the fabrication of light-gauge metal items. Later, the company joined a pool of smaller industries known as Omaha Industries, Inc., which agency offers the facilities of the entire group as one unit in bidding on war work.

By sticking to their pre-war specialty of light-gauge metal fabrication, Sterling had available a nucleus of trained workers around which they could expand their operations in this field in such a way as to make maximum use of the "know how" already existing in their organization.

Some minor machine shop operations were part of this company's pre-war experience, too, and they have taken contracts in this field commensurate with their equipment and experience. Woman-power has solved the labor problem in this field: "And better, too", says lanky, red-haired E. J. Grafentin, Sterling's energetic proprietor. "These girls are better on many small operations than the men. See that girl over there? She's drilling a $\frac{1}{8}$-in. hole in a 7/16-in. bolt and she'll turn out 3000 of them a day. The young fellows we had on that job before had a big day if they turned out 2000."

More space has been acquired for manufacturing, more workers employed, more material processed; but all the expansion has been accomplished with materials and processes with which the company was already familiar.

The electroplating department has been enlarged by addition of new baths equalling the number of old, thus doubling the capacity. Though nickel and chromium have been stringently restricted by War Production Board orders, copper, brass, bronze, and silver have been more readily available. Bulk of the firm's plating is still confined to items of Sterling manufacture, (now war goods items rather than fixtures and ornamental metals) but some commercial plating is done for priority customers.

Electroplating with zinc was but a short step, and then came Parkerizing, a hot-dip chemical process (non-electrolytic).

In contemplating the postwar future, Grafentin feels a little like the prodigal son: It will be like going home to get back into the same lines of endeavor Sterling pursued before war was de-

[Continued on page 184]

"Mr. Tops," The Paragon Symbol of Top Quality.

LET "MR. TOPS" CONTROL YOUR TIMING of

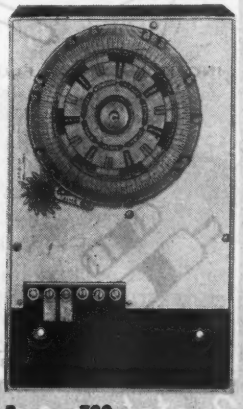
Automatic HEATING, VENTILATING, LIGHTING, PUMPING OR FLUSHING OPERATIONS

Paragon 700 Series Time Switches are equipped with 6" calendar dials which make one complete revolution every 7 days. Dial trippers can be independently set for different daily ON and OFF schedules. Settings can be made in advance for an entire week. Any day or days operations may be omitted entirely on a pre-set program.

Each day of week clearly separated from other days; graduated into hours and half hours; day and night distinctly separated. Operations from ON to OFF or from OFF to ON can be set as close as three hours apart and can be separately adjusted throughout each 24 hour day in the week.

Write for a complete engineering bulletin.

PARAGON ELECTRIC COMPANY
710 Old Colony Building
Chicago 5, Illinois



Paragon 700 Series Time Switch

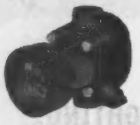
SEE YOUR JOBBER

Paragon Chicago
BUILDERS OF ELECTRICAL EQUIPMENT SINCE 1905

WHAT THE HEART IS TO LIFE
THE SWITCH IS TO A CONTROL
Either Case, When One Fails All Else Ceases To Function

TEMPERATURE AND PRESSURE CONTROLS

EXPLOSION PROOF CONTROL



LIQUID LEVEL CONTROLS

As long as the blood stream is permitted to flow through the heart, the human machine goes on, fulfilling its destiny. Likewise, as long as the electrical current is permitted to flow through the switch the control fulfils its designed purpose in whatever automatic heating or industrial application it may be used with.

The relative importance of a switch is sometimes overlooked, especially in an automatic control. In the event of a switch failure, as in the case of a boiler pressure or temperature limit control, as well as other important applications, the failure may prove hazardous and costly. That is why from the very beginning, Mercoid Automatic Controls were equipped exclusively with the now famous hermetically sealed Mercoid mercury switches, known and used the world over. They provide an electrical contact designed for millions of perfect operations —one reason why Mercoid Controls are noted for their long life and better performance. Mercoid switches are immune to dust, dirt, moisture or corrosion. They are not subject to open arcing, pitting or sticking of the contacting surfaces. That is the reason why Mercoid Controls are following the Army in some of the far outposts where adverse and extreme humid weather conditions exist.

There are many other important features incorporated in Mercoid Controls, but in the meantime, remember the all-important Mercoid Switch—the unfailing heart of Mercoid Controls.

THE MERCOID CORPORATION, 4221 BELMONT AVENUE, CHICAGO 41, ILLINOIS

MERCOID DA CONTROLS

FOR THOSE TEMPERATURE OR PRESSURE CONTROL PROBLEMS

Millions of Steel

JIFFY CLIPS

Serving the Electrical Industry

Specify
MINERALLAC
HANGERS, CLIPS, STRAPS, BUSHINGS

Expert design, choice materials and controlled manufacture have built "top-service and longest life" into Minerallac Electrical Specialties. That's why the electrical industry "prefers Minerallac"... In steel and Everdur for hanging pipe, conduit, BX cable, etc.

Send for new literature and prices.

MINERALLAC ELECTRIC COMPANY
25 North Peoria Street—Chicago 7, Illinois

MINERALLAC

SOLAR
Electrical Products

Quotation on request

SOLAR ELECTRIC CORPORATION
WARREN, PENNSYLVANIA

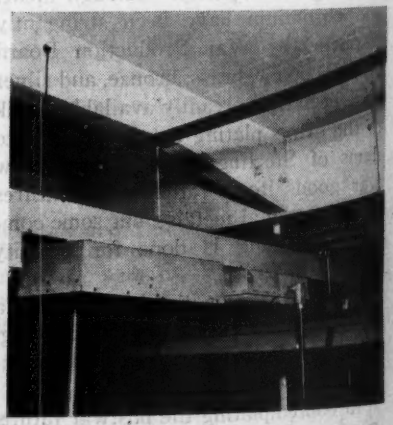
War Know-How Makes Postwar Jobs [FROM PAGE 183]

cleared. And "Red" Grafentin wants to "go home", but—he isn't sure what kind of welcome will be awaiting him and the many others who have given up their peace time programs in order to further the war effort and stay in business. He looks to a modest expansion of the company's pre-war manufacturing of fixtures and ornamental metals with postwar sales effort mainly directed toward supplying the large institutional and commercial market rather than the individual home owner. The remodeling and refurbishing of railroad cars, and conversion of transport planes to deluxe passenger airliners is also expected to make up an important part of Sterling's postwar market.

Primary Loops Serve Pratt & Whitney [FROM PAGE 42]

the network of branch conduits also cast in the concrete building structure (roof).

The bus duct power distribution is shown by Fig. 2. The two 2000 amp. air breakers are manually operated from the front of the board and under normal operation are both closed feeding their respective lines of bus ducts. However, under an emergency condition when normal power-feed is interrupted for any reason, partial operation can be continued by opening the two main breakers and closing the 2000 ampere tie-switch mounted in the back of the board. The 2000 ampere tie switch (shown in Fig. 2 midway between vaults 3 and 4) must also be closed permitting feed-through from



Plug-in capacitors neutralize reactive currents. Duct is supported from inserts in concrete beams. Note angle iron atop duct, and messenger supporting fluorescent lines while at the same time acting as sway brace for duct.

Typical lighting panel and riser trough. Mains come up from floor. Branch circuits enter ceiling in conduit. Note branch outlet in center of nearest fluorescent line. Messenger runs through inserts in concrete beams providing perfect alignment.

the other vault. Referring to Fig. 1, it is noted that vaults 3 and 4 may be tied through their secondaries while their primaries feed from different loops. The same is true of vaults 2 and 5. This provision in the design gives great flexibility in normal operation (in addition to insurance against complete outage in any area) since capacity can be borrowed from opposite vaults for the duration of any abnormal concentration of load on any part of the sectionalized bus.

Fused tap boxes are placed in the 2000 amp. mains at each point where the perpendicular runs of plug-in duct takes off. In general, 500 amp. duct is used for these branch plug-in runs. Plug-in capacitors are attached to the bus duct system at various points where highly inductive loads are connected. In this manner the active capacity of the busbars and primary equipment has been increased, and a higher plant power factor has been obtained.

Rigid conduit drops from the plug-in switches drop directly to the machine-tools or other loads on the floor.

As seen in the accompanying photographs, the bus duct is hung from inserts in the concrete structure. Additional strength is given to the bus duct by welding angle iron lengths to the top-side permitting greater spans.

The duct is given sway-brace support by a messenger cable system at right angles which is used to support the continuous-strip fluorescent lines. Thus the two perpendicular systems serve to give the other sway support.

The fluorescent lines are composed of two 40 watt lamp units mounted on 14 foot centers and at a height of 16 feet. Maintained illumination averages 40 foot-candles.

THE REFLECTOR IS THE BACKBONE OF ANY LIGHTING SYSTEM . . .

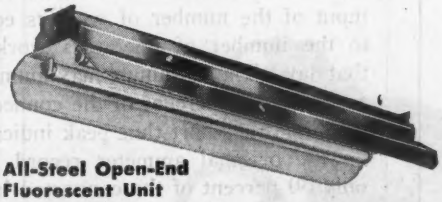
Scraping Dept. Gould & Eberhardt, Inc., Irvington, N.J.

"Day Shift" production around the clock!

When you give workers *Skilled Lighting* . . . the product of Wheeler's advanced engineering . . . you improve morale, bring daylight speed and accuracy to the job 24 hours a day!

That's one big reason why it's important to install Wheeler Reflectors – product of 64 years of specialized light engineering. Wheeler Units are engineered to provide maximum light from standard lamps. Their high reflection factor puts light to work where it belongs – on the job. Made of heavy gauge metal, coated with vitreous enamel, their rugged construction insures long service, easy maintenance.

Learn how these better-engineered units can bring *Skilled Lighting* to your production scheme. Send for catalogs showing complete line of incandescent and fluorescent fixtures. Wheeler Reflector Company, 275 Congress St., Boston 10, Mass. Also New York. Representatives in principal cities.



All-Steel Open-End Fluorescent Unit

Available for two or three 40-watt, or two 100-watt lamps. Broad wiring channel with accessible, enclosed ballast. Can be mounted from chain or conduit, individually or in continuou runs.

RLM Solid Neck Incandescent Reflector

Maximum lighting efficiency for either indoor or outdoor use. Expertly designed, ruggedly built. 75 to 1500 watts.

Distributed Exclusively Through Electrical Wholesalers

Wheeler Skilled Lighting REFLECTORS

Made by Specialists in Lighting Equipment Since 1881

—at ANY outlet of ANY Kondu fitting.

Just slip out one bushing and slip in another. No extra pieces are needed.

Every Kondu box is a union, and can be taken out of the line without disturbing conduit.

Practically unbreakable, Kondu fittings are 100% re-usable. Self-aligning . . . vibration-proof.

Write for the Kondu catalog.

KONDU CORPORATION
Erie, Pa.

KONDU MFG. CO. LTD., Preston, Ontario

KONDU

War Presses Industry Progress

[FROM PAGE 80]

factor corrected welders with permanently connected capacitors are used.

Table 1 can also be used when welders are distributed among the phases of a three-phase circuit, by the following procedure: Consider each group of three welders connected to the three phases as a single unit of current rating 1.73 times the primary rating of an individual welder and use the table as though the three were a single welder.

If a large number of welders without power factor correction operate as a group, diversity begins to influence both maximum demand and peak demand. Fig. 5 shows the shape of the welding load curve for a group of 238

TABLE I

Numbers of Welders	Add for Each Welder, Line Capacity Equal to The Following Percentage of Rated Primary Current of One Welder
First and Second Welder	100
Third Welder	85
Fourth Welder	70
All Additional	60

operators in a shipyard. (The recording ammeter from which this curve was derived actually measured one-seventh of the total load, which accounts for the relatively low currents indicated.) The average load was one-quarter of the connected load, indicating an average all-day duty factor of 25 percent. (In this case connected load is assumed to be the total rated input of the number of welders equal to the number of operators working that day.) The 15-minute maximum demand was 26 percent of the connected load, and the short-time peak indicated on the original ammeter record was only 30 percent of the connected load.

A Portable Instrument for Measuring Insulation Resistance at High Voltage

There has been an increasing trend toward measuring insulation resistance of high voltage machines and cables at or above their rated voltage by the use of direct current. The advantage of high voltage lies in its ability to detect leakage paths which do not occur at lower voltages. Direct current tests are advantageous because of the elimination of capacity current effects. Since the resistances measured are usually quite high—of the order of megohms—if high voltage alternating current is used to test insulation, even small load capacities offer impedances low enough to mask the insulation resistance effect.

A suitable portable instrument of rugged construction has recently been made possible by the development of a new cold cathode rectifier tube. By use of voltage-multiplying circuits, practical power units producing up to 200 kv. have been built. Even higher voltages are feasible. Such high voltage power units are characterized by light weight, compactness, and air insulation in the high voltage portion of the unit. Small high voltage transformers are used since the maximum a-c voltage required is 3 kv. rms.

To assist in evaluating the performance of aircraft ignition systems, the instrument was developed to measure the insulation resistance of cables, and other ignition parts such as magnetos, distributor blocks, heads, fingers, sleeves, and plates at or above their operating voltages. The range of the instrument is 10 to 10,000 megohms measured at any voltage between 2500 and 15,000 volts. The outside dimensions of the instrument are 10 in. by 11½ by 18½ in., and it weighs 31 pounds.

Although this instrument is now used primarily for testing aircraft ignition cable, some exploratory work with it has been done in the industrial field to determine test requirements there. Insulation resistance and dielectric absorption measurements have been made on sections of a 25,000 kva., 6900 volt class vertical water wheel generator. The winding to ground capacitance of this generator is approximately 0.13 microfarads per section or 0.4 microfarads for the entire machine.

Insulation resistance of a 350,000 circular-mil, three conductor, impregnated paper, compound filled, lead sheath cable, rated at 15 kv., 18,385 ft. long (3½ miles), was measured with the instrument as well as with an accepted 1000 tester for comparison.

These and other tests indicate that for the industrial field other current meter ranges would be desirable. Possible ranges might include a unit for measuring insulation resistance at 2500, 5000, 10,000, and 15,000 volts with current ranges of 0-25 microamperes, 0-250 microamperes, and 0-2500 microamperes. This would result in a unit with an insulation resistance range from ½ to 30,000 megohms.

Design for Sealed Ignitron Rectifiers for Three Wire Service

The field of application of the ignitron rectifier is considerably enlarged by the introduction of equipments for three-wire service, and it is the purpose of this paper to describe the design, characteristics and performance of these units.

One field of usefulness of the three-wire rectifier is for supplying d-c power to industrial three-wire systems. There is another application to be found in metropolitan districts where steps are being taken to retire the Edison three-wire d-c system and existing

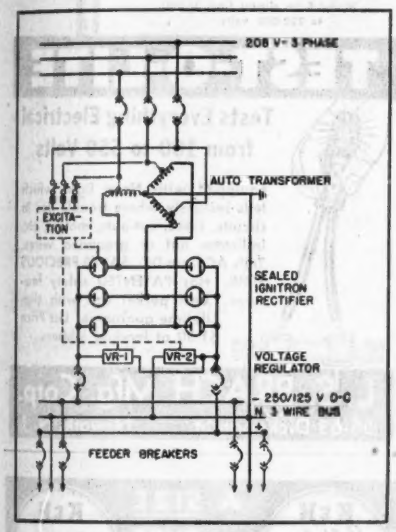


FIG. 6—Six-phase, Double-way, Three wire rectifier

building generating plants. In many cases it will not be economical to rewire buildings for a 208 volt three phase, 60-cycle supply or to replace d-c motors and control for a-c operation. The problem of supplying d-c power for three-wire systems without the installation of rotating apparatus has long delayed the conversion in many districts.

Three-wire sealed ignitron rectifiers offer several distinct advantages when compared with other forms of converting equipment. The rectifier is largely static, thus eliminating special foundation and space requirements. Rectifiers are quiet in operation and easy to operate. The no-load losses are small and the efficiency is fairly constant and reasonably high over the entire load range. Rectifier equipments are factory assembled as unit d-c substations thereby minimizing installation time and expense.

Rectifier ratings and the number of units required will depend upon the application. For elevator loads, particularly in hotels, apartment houses

[Continued on page 188]

Time Tested OAMCO Reflectors for Modern FARM LIGHTING

The complete line of Overbagh & Ayres Farm fixtures and reflectors are engineered to more than meet the lighting requirements of all indoor and outdoor farm working areas. Designed and constructed to withstand hard usage, these units will deliver long service under the most severe conditions. Send today for our Farm Light Bulletin #107.

YARD LIGHT FIXTURE

Consists of: cast wall flange, ½" conduit stem, porcelain enamel steel reflector, porcelain socket, lag screws and wire cut to right length.

SHALLOW DOME REFLECTOR

Available in either porcelain enamel or synthetic enamel finish, green outside, white inside. Type A neck for 2¼" shade holder. Made in 4 sizes for 60, 100, 150 and 200 watt lamps.

DEEP CONE REFLECTOR

Made of steel finished in synthetic enamel, green outside, white inside. Furnished in 3 sizes, 8", 10", & 12" diameters.

HANDY OUTDOOR FLOODLIGHT

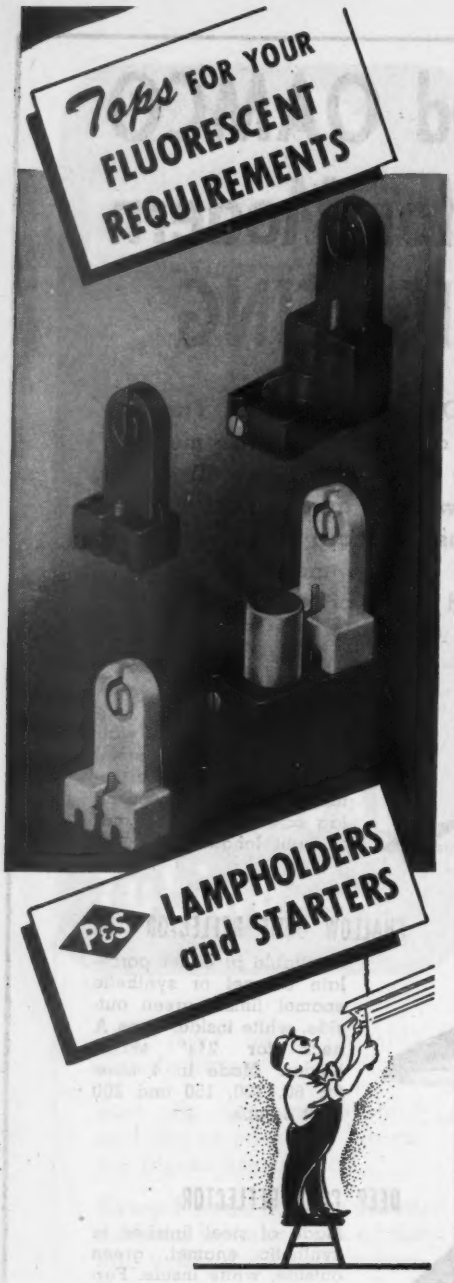
Consists of: Porcelain enamel steel, green outside, white inside, adjustable bracket allows the reflector to swing in any horizontal or vertical position. Wired with 5 feet of cord & plug. Furnished with or without clear glass cover.

RIGHT LIGHT SINCE 1902

OVERBAGH & AYRES MFG. CO.

MEMBER OF THE R L M STANDARDS INSTITUTE

411 SOUTH CLINTON STREET • CHICAGO



If it's Fluorescent Lampholders and Starters you need, turn to your P&S Catalog — Be sure of the dependable performance which has characterized P&S Wiring Devices for over fifty years.

Sold Thru Electrical Wholesalers

Catalog on request.

PASS & SEYMOUR, INC.
SYRACUSE 9, NEW YORK

War Presses Industry Progress

[FROM PAGE 187]

and office buildings it is good practice to have a 100 percent reserve or standby unit, which will permit the rectifier in service to be removed. For reasons of safety, such service must continue under all conditions and a satisfactory solution to the problem is to provide two complete independent rectifiers with provisions for rapid changeover in case of d-c voltage failure. Simple switching provides preselection of normally operating and reserve rectifiers. Where requirements are less severe and where units may be removed for maintenance and inspection, it is not necessary to provide a standby unit.

The Application of Silicone Resins To Insulation For Electrical Machinery

The advent of silicone resins is an important milestone in insulation development as these resins in combination with inorganic insulations such as mica, asbestos and fiber glass have unusually high thermal endurance. It appears that designers may utilize this excellent temperature resistance in three important ways, when permitted by AIEE standards.

1. To reduce size and weight of some apparatus through increase in operating temperature.
2. To permit operation in a high ambient temperature.
3. To obtain increased insulation service life or reliability where it is desired to maintain conventional size, weight and temperature.

Since the silicone resins are characterized by extreme heat stability, it would be reasonable to suppose that they would also require higher temperatures for drying and processing. At the present time this is the case for most of these. It has been found that electrical machines insulated with silicone varnishes must be baked at temperatures from 200 to 250° C. for times which are comparable to standard processes using organic varnishes. There is some indication, from recent experimental work, that this condition will not always exist.

Numerous totally enclosed fan cooled induction motors have been made using high temperature silicone insulation and subjected to operation at high temperature. None of these motors as yet show any marked deterioration of the insulation as indicated by insulation

Safe-T-Glow

HIGH TENSION DETECTOR

SAFETY RULES call for that EXTRA precaution and additional RE-CHECK which SAFE-T-GLOW provides. Detects accidental tie-ins, crossovers, leakages and induced voltages . . . prevents serious injury and loss of life. SAFE-T-GLOW consists of a sensitive Neon tube, amplified by mirror reflector.

Model A for circuits 2,000 to 35,000 volts.
Model B for circuits from 35,000 to 220,000 volts.

TEST-O-LITE

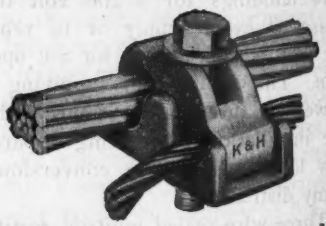
Tests Everything Electrical from 100 to 550 Volts

Equipped with Neon light which tells instantly where trouble lies in circuits, fuses, cut-outs, motors, etc. Indicates hot or grounded wires. Tells AC from DC. SAVES PRECIOUS TIME. Has PATENTED safety features. Vest pocket size with clip. Lifetime guarantee. List Price $1.50 at leading jobbers.

L. S. BRACH Mfg. Corp.
55-63 Dickerson St. Newark, N. J.

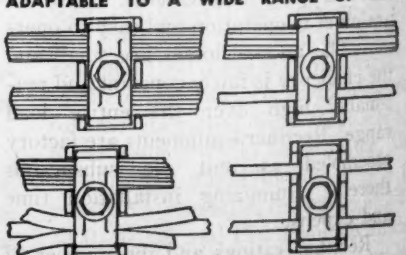
K&H Solderless Terminal LUGS — A SIZE and TYPE for every need! — K&H Solderless CONNECTORS

UNIVERSAL Tap Connector



Effectively used as guy line ground, or transformer and lightning arrester connection to A. C. S. R. or copperweld conductors where the diameters may be from 8-A copperweld to .595" A. C. S. R. armour rods. Wire sizes .595" to 5/32".

ADAPTABLE TO A WIDE RANGE OF USES



WRITE FOR BULLETIN 8-B

KRUEGER & HUDEPOHL
232-8 VINE ST. ★ CINCINNATI 2, OHIO

resistance readings and all motors have been subjected to high potential tests with no breakdowns. The following motors with the operating temperature and time of operation up to date are still under test.

Motor	Winding Temperature	Hours
2 Hp.	170°C.	3486
2 Hp.	165°C.	3486
4 Hp.	140°C.	3996
4 Hp.	160°C.	3996
7½ Hp.	320°C.	1907
7½ Hp.	320°C.	1907
15 Hp.	185°C.	3506
15 Hp.	170°C.	3506
25 Hp.	160°C.	3291
25 Hp.	135°C.	3291
6 Hp.	285°C.	4500
10 Hp.	250°C.	3400
10 Hp.	250°C.	3400
25 Hp.	240°C.	3300
10 Hp.	200°C.	5200
10 Hp.	185°C.	3200

How to Use Shunt Capacitors

[FROM PAGE 73]

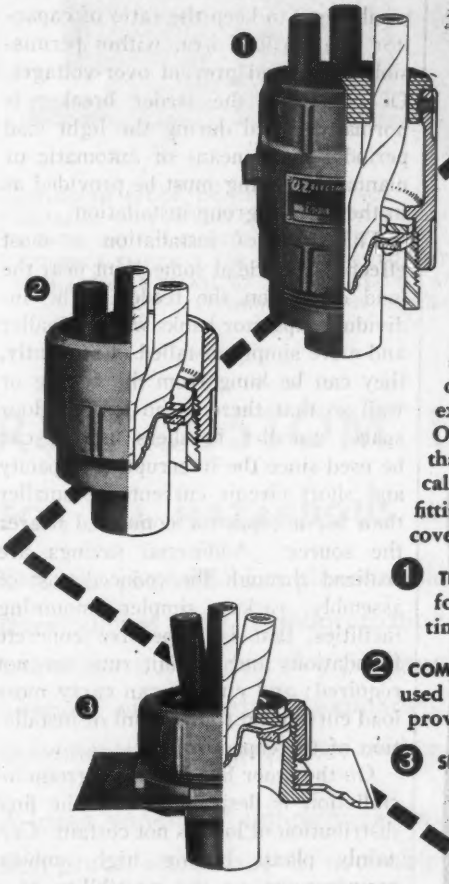
conjunction with the rate schedule. During certain times of the day, the load may drop to a small value. A high ratio of capacitor kva. to load kva. under light load conditions can cause overvoltages on a system, since the lagging reactive kva. decreases as the load decreases while the capacitive kva. remains constant. The result is a net capacitive kva. or leading reactance causing a voltage rise. The voltage rise is not usually sufficient to cause insulation stress, but it does cause over-excitation of transformers and motors. If the circuit is used for lighting, the voltage rise will shorten the life of lamps. The over-excitation of transformers causes an increase in the harmonic content of the exciting current.

Records show that most failures of equipment caused by over-excitation occur during the night and over week-ends when industrial plants are lightly loaded. Manual control of the capacitor kva. is, therefore, possible. The entire bank or sections of the bank can be removed from the circuit manually during periods when the load is light.

Group Installations on Individual Feeders

A bank of shunt capacitors can be connected to each feeder either at the plant distribution bus or at some point along the feeder. The bank would be applied to correct the power factor of the load connected to the particular feeder. Frequently, the feeder breakers

NOW THERE'S AN O.Z. INDOOR CABLE TERMINATOR FOR EVERY JOB

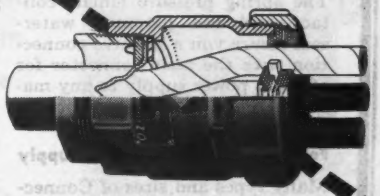


O. Z. has added many new fittings to their line of Cable Terminators to meet the increased demand for their use in sewerage disposal plants, oil refineries, steel mills, office buildings, power stations, synthetic rubber plants, pumping stations, chemical and industrial plants, etc. In expanding their line of Cable Terminators, O. Z. engineers have drawn upon their more than 25 years close association with electrical industries to produce a complete line of fittings for use with lead covered and rubber covered cables in the following classifications:

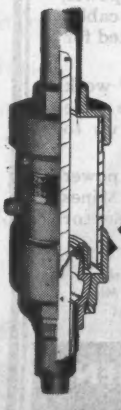
1. **TERMINATING POTHEADS,** substantial units for sealing conduit and cable ends. This fitting has ample space for sealing compound.
2. **COMPOUND BUSHINGS,** compact sealing units used where space is limited. Small reservoir is provided for compound.
3. **SEALING BUSHINGS,** for use in cabinets, control boxes, etc. No compound chamber is provided and with its reduced height a minimum of space is required.

AT A GLANCE, find the proper fitting among 55 classified photo-diagrams, each complete with description, dimensions and prices in O. Z.'s new 144-page catalog. Results of tests made by an independent testing laboratory will be found on page 24 of the catalog. Contains similar information on more than 160 O. Z. fittings including CONDUIT FITTINGS • JUNCTION BOXES • SOLDERLESS CONNECTORS • POWER CONNECTORS • GROUNDING DEVICES.

Designers and engineers who are planning post war building or reconversion can enjoy the purchasing advantage of using O. Z. as a single high-quality source of supply. Write on your business letterhead for your free copy.

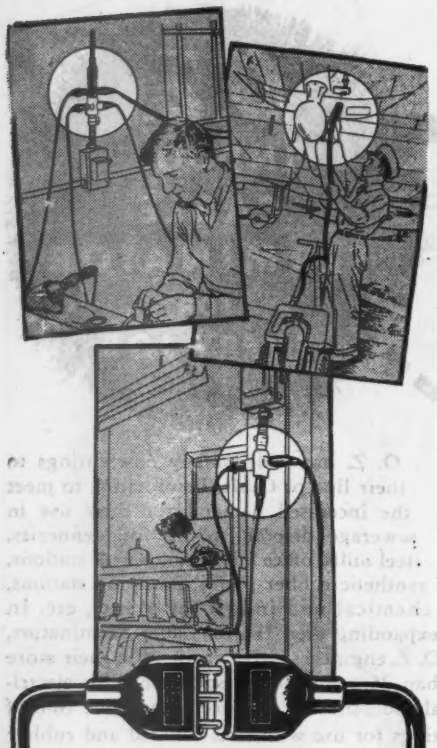


HORIZONTAL TERMINATORS have an added sealing device at the top, permitting their use in any position.



"J" TERMINATORS incorporate the general principles of O. Z. Terminators, with the addition of a collapsible feature making an easily installed device for terminating and sealing or as a pulling and splicing chamber.

O. Z. ELECTRICAL MFG. CO.
262 BOND STREET • BROOKLYN, 2 N. Y.
REPRESENTATIVES IN PRINCIPAL CITIES



MINES

Water-Seal Cable Connectors Transmit Power to the Job Safely and Efficiently

Mines Cable Connectors are molded right on the rubber cable so that the connector becomes a part of the cable itself. The spring pressure female contact and the patented water-seal assure you a positive connection with the male connector for efficient power supply to any machine under all plant conditions.

For Any Portable Power Supply

Many types and sizes of Connectors have been developed, making them adaptable to almost any industrial application where power is transmitted by portable cable. Standard connectors are rated for loads to 600 volts.

Our engineers will gladly work with you in solving portable cable applications on capacities up to 5000 volts and 325 amps.

For efficient, safe, flexible power transmission by cable, use Mines Connectors — "The Connector with the Water-Seal."

WRITE FOR BULLETIN MC-106, showing many successful applications of Mines Connectors throughout industry.

MINES EQUIPMENT COMPANY

4230 Clayton Road
St. Louis 10, Missouri

How to Use Shunt Capacitors

[FROM PAGE 189]

are opened during the night or other light load conditions, and the capacitor can be removed with the load. This would tend to keep the ratio of capacitor kva. to load kva. within permissible limits and prevent over-voltages. Of course, if the feeder breaker is normally closed during the light load periods, some means of automatic or manual switching must be provided as in the case of group installation.

This type of installation is most effectively made at some point near the load center on the feeder. The individual capacitor banks will be smaller and more simply installed. Frequently, they can be hung from the ceiling or wall so that there is no loss of floor space. Smaller breakers usually can be used since the interrupting capacity and short circuit current are smaller than for a capacitor connected nearer the source. Additional savings are realized through the reduced cost of assembly racks; simpler mounting facilities, that is, expensive concrete foundations and conduit runs are not required; and circuits can carry more load current up to the point of installation of the capacitor.

On the other hand, a large group installation is desirable where the final distribution of load is not certain. Certainly plants having high ambient temperatures or the possibility of a corrosive atmosphere should make a group installation outside the plant.

Capacitors installed at or near load centers can be supplied with automatic switching which can be used to regulate voltage as well as power factor on the feeder as explained above. Other methods of control may be used such as current or reactive kva.

Connecting Capacitors to Individual Motors

The most effective method of providing for removing capacitors during light load conditions is to connect the capacitors directly to the terminals of the load, so that when the load is removed from the line the capacitor is also removed. Since induction motors constitute the major part of the low power factor load, it is ordinary to find individual capacitor units connected to the motor terminals on the load side of the starter.

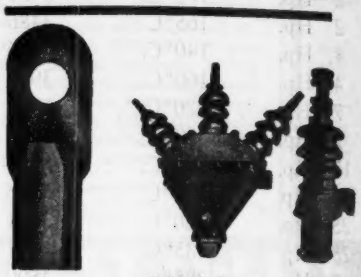
If an induction motor having shunt capacitors connected to its terminals is disconnected from the source, the capacitors will provide excitation cur-

ELECTRICAL SPECIALTIES

RMC

FOR HEAVY INDUSTRIAL SERVICE

FROM STOCK



Soldering Lug — 3-Conductor Angle Pothead — Single Conductor Pothead

Write for a complete selection of RUSGREEN bulletins

ENDULATORS (POTHEADS) ALL SIZES • ALL SHAPES • ALL VOLTAGES • ALL TYPES • BUS SUPPORTS • SPLICING KITS AND MATERIALS • INSULATING COMPOUNDS

★ ★ ★

RUSGREEN MFG. CO.

14260 Birwood Avenue • Detroit, Mich.

Wanted

ENGINEERS

Radio
* Electrical
Electronic
* Mechanical
* Factory Planning
Materials Handling
Manufacturing Planning

Work in connection with the manufacture of a wide variety of new and advanced types of communications equipment and special electronic products.

Apply (or write), giving full qualifications, to:

R. L. D., EMPLOYMENT DEPT.

Western Electric Co.

100 CENTRAL AV., KEARNY, N.J.

*Also: C. A. L.
Locust St., Haverhill, Mass.

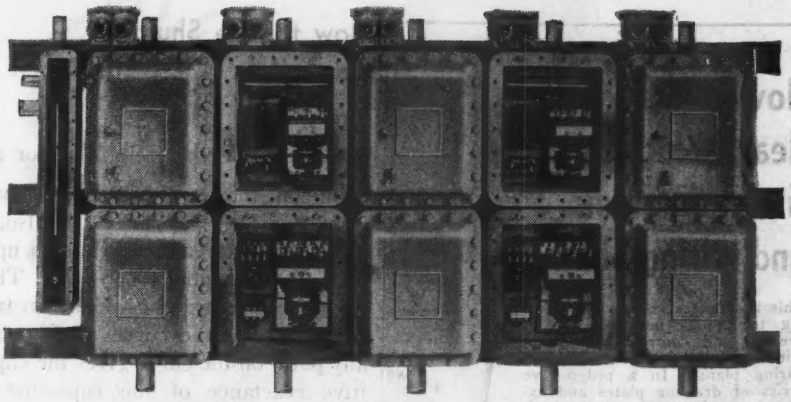
Applicants must comply with WMC regulations

rent for the motor causing it to act as an induction generator under certain conditions. If the capacitor is large enough and if the inertia of the motor and its load is high, a high voltage will be generated, which can cause insulation failures in capacitors or motors. The higher the ratio of capacitor kva. to motor horsepower, the higher the voltage produced, assuming the motor speed to be constant for a short time after disconnection. On certain applications where a high inertia load keeps the motor running at nearly constant speed or where there is a possibility that the motor may over-speed, care must be exercised that the capacitor is not large enough to cause a self-excitation which will produce excessive voltages. Aside from causing insulation stress, the high voltages will cause higher than normal currents which cause arcing and subsequent burning of contacts on the line contactor or starter when the circuit is opened. It is difficult to determine just how large the capacitor can be without causing voltages which are too high unless the characteristics of the induction motor are available. However, if the running saturation curve of the motor is available, it is a relatively simple procedure.

Principle of Self-Excitation

For the purpose of analysis, consider the rotor of the induction motor to be driven by d-c motor at synchronous speed. If a three-phase bank of capacitors be connected to the terminals of the induction motor, it will act as an induction generator at no load. The equivalent circuit for this condition is shown in Fig. 1(a). Since only the no-load losses of the machine are supplied by the shaft input, the quantity $\left(\frac{1-s}{s}\right) r_r i_r^2$ will be very small. Satisfaction of this condition requires that s and i_r be very small. The equivalent network for this operating condition can be reduced, for all practical purposes, to that shown in Fig. 1(b). When the machine is driven at synchronous speed the slip s is zero, and the generated frequency is essentially that of the shaft. A 15 hp., 3-phase, 60 cycle, 220 volt, 1770 rpm. type CS Westinghouse motor of conventional design was driven in this manner, and the size of the capacitor varied over a range to give the test points indicated by the crosses in Fig. 2. The test points extend the no-load excitation curve to more than ten times normal excitation current.

Referring to the equivalent circuit

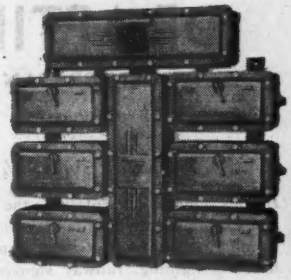


EXPLOSION PROOF CONTROL PANEL FOR FIVE GROUPS OF ELECTRICAL STRIP HEATERS INSTALLED ON ETHYLENE GAS PIPE LINES & DRUMS. THE PANEL MADE UP OF FIVE SECTIONS & EACH SECTION CONTROLS SEPARATELY ONE GROUP OF HEATERS. A MOTOR OPERATED SEQUENCE SWITCH & TEMPERATURE INSTRUMENTS (NOT SHOWN) OPERATES THE VARIOUS CONTACTORS & RELAYS SO THAT THE HEATERS ARE CONNECTED IN PARALLEL OR IN SERIES DEPENDING ON THE TEMPERATURE REQUIREMENTS.

R&S CUSTOM BUILT PANELS

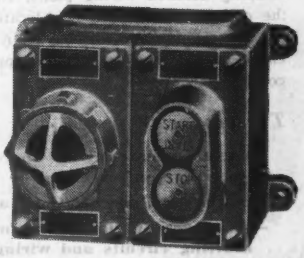
FOR ALL HAZARDOUS AREAS

Over the years R&S has pioneered in the development and standardization of precision-built control equipment in keeping with industries' expanding requirements of new processes and codes.



CIRCUIT BREAKER PANEL FOR LIGHT OR POWER

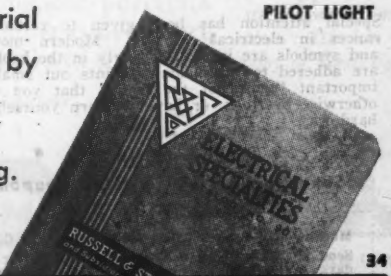
A large variety of standardized explosion-proof enclosures is available for grouping and assembly of control and power units in panel form, at minimum cost and without the usual delay of special designs.



PUSH BUTTON STATION WITH PILOT LIGHT

R&S Standard Enclosures have wall sections permitting a great variety of conduit arrangements and sizes to suit job requirements. This simplifies material lists and reduces inventories caused by field changes.

Ask for the 300-page R&S Catalog.



Since 1902

Please address Dept. No. A

34

RUSSELL & STOLL COMPANY

EXPLOSION-PROOF, WATER-TIGHT, INDUSTRIAL LIGHTING FIXTURES AND EQUIPMENT. AUTOMATIC LOCKING "EVER-LOK" CONNECTORS

125 BARCLAY STREET · NEW YORK 7, N. Y.

How to draw clear, accurate circuit diagrams and wiring plans

This book gives you tested drafting techniques needed in engineering and contracting, as applied to electrical circuits and wiring plans. In a progressive series of drawing plates and explanatory discussions, the book shows how to develop detailed wiring plans from the schematic circuit diagram, how to correlate the equipment-location plan, and how to check the design and execution of the finished drawing.

Get the benefit of years of drafting experience in many electrical fields to turn out better, more accurate diagrams and wiring plans.

Just Published!

ELECTRICAL DRAFTING

By D. WALTER VAN GIESON

Assistant Electrical Engineer, Board of Transportation, City of New York

140 pages, 5¼ x 8¼, $1.50

In this unique presentation, the author describes and explains drawings taken from actual working installations to show typical applications in such fields as lighting, railway signals, communication, radio and television, and power—and including as well car, aircraft, and ship wiring plans, traffic signals, animated signs, and neon and fluorescent lighting. Besides treating the procedure for developing detailed wiring plans, the book explains the correlation of equipment-location and conduit-location plans, and discusses in detail how to check the finished drawing for proper design and correct execution.

The book gives you—

- **—valuable material on the principles of electricity and electronics**
- **—useful data, specifications, and rates**
- **—six pages of electrical symbols used in drafting circuits and wiring**
- **—helpful tips on some of the "kinks" and shortcuts in drafting room procedure**
- **—practice problems and test questions**

Special attention has been given to recent advances in electrical drafting. Modern methods and symbols are introduced early in the book and are adhered to throughout. Points out small but important "tricks of the trade" that you might otherwise overlook, or have to learn yourself, the hard way.

SEE IT 10 DAYS

Send this* McGRAW-HILL *coupon

McGraw-Hill Book Co., 330 W. 42nd St., N.Y.C. 18

Send me Van Gieson's Electrical Drafting for 10 days' examination on approval. In 10 days I will send $1.50, plus few cents postage, or return book postpaid. (Postage paid on cash orders.)

Name .....

Address .....

City and State .....

Company .....

Position .....EC 3-45

(Books sent on approval in U. S. only.)

How to Use Shunt Capacitors

[FROM PAGE 191]

in Fig. 1 (b), the ratio $\frac{e}{i_m}$ for any point on the excitation curve must equal $(X_m + X)$ or X_c. Also, in order that the reactive kva. sum up to zero, X_c must equal $(X_m + X)$. Thus, the slope of a straight line drawn from the origin of the curve of Fig. 2 to any point on the curve gives the capacitive reactance of the capacitor required to produce that voltage at no load. As the condenser capacity decreases, the slope of the line will increase and the terminal voltage decrease. When a slope is obtained which coincides with the air-gap line of the excitation curve, there are an infinite number of solutions. Beyond this point the machine is inoperative. The conclusion is that there is a definite minimum value of capacitive reactance which will produce self-excitation.

In the particular case of interest, there is no d-c motor to drive the induction motor and the maintenance of a speed somewhere near synchronous speed depends upon the inertia of the rotor and its shaft load. As stated before, the frequency of the generated voltage corresponds to that of the shaft. At higher values of capacitor kva. it will decrease slightly from this value due to wave distortion and losses. It is of particular interest to determine how the voltage produced by self-excitation will vary with variation in shaft frequency or slip.

The full lines of the insert of Fig. 3 show the magnetizing characteristic and a capacitor characteristic for normal frequency. As the frequency is increased, the terminal voltage for a given magnetizing current increases proportionately with the frequency. On the other hand, the capacitor current varies inversely proportional to the frequency. These characteristics are shown by the dotted lines for an increase in frequency of about 20 percent. The new terminal voltage is then given by the intersection of the dotted lines. Of course, for a drop in frequency the converse of the above is true and there is a decrease in the new terminal voltage. The curve of voltage plotted against frequency shows the variation with a constant shunt capacitor at the terminals of the same motor used in Fig. 2. The comparison between test and calculated results using this method are shown by the circles and crosses in Fig. 3 which indicate a very close agreement.

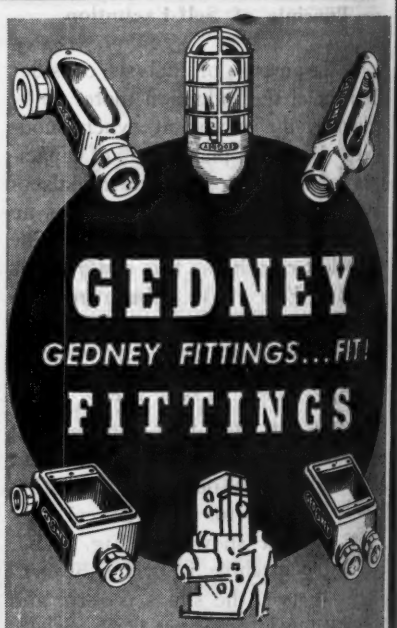
Free!

RADIO & ELECTRONIC TEST EQUIPMENT AVAILABILITY BULLETIN

Contains detailed descriptions of models we're now making.

We manufacture Volt-Ohm Milliammeters, Insulation Testers, Signal Generators and Tracers, Industrial Analyzers, Voltage Testers, etc.

SUPERIOR INSTRUMENTS CO.
Dept. 156
227 Fulton St. New York 7, N. Y.



GEDNEY Fittings and Conduit Bodies are rigidly inspected, cleanly finished and carry the approval of Underwriters Laboratories. They are carefully packed in metal-edge cartons convenient quantities, clearly labeled. Wholesale distribution only. Write for catalog.

GEDNEY ELECTRIC COMPANY
RKO BLDG. RADIO CITY NEW YORK, N. Y.

The majority of motors generate a voltage of about 165 percent of normal when the capacitor kva. is numerically equal to the horsepower. The dashed line in Fig. 2 was calculated, to show the terminal voltage as a function of the kva. of the capacitors at normal frequency and voltage. A rule that is being tentatively followed by manufacturers is that the recommended size of capacitor should not be greater than that required to correct the no-load power factor to unity. Following this rule will eliminate any danger due to self-excitation. If it is desired to use a larger value of capacitor, the capacitor should be chosen by calculation or tests after installation so that the self-excitation voltage will not exceed 165 percent of the capacitor rated voltage, provided the duration of 165 percent voltage does not exceed twelve minutes. However, this may not be a safe voltage for the motor insulation and the manufacturer should be checked on this point.

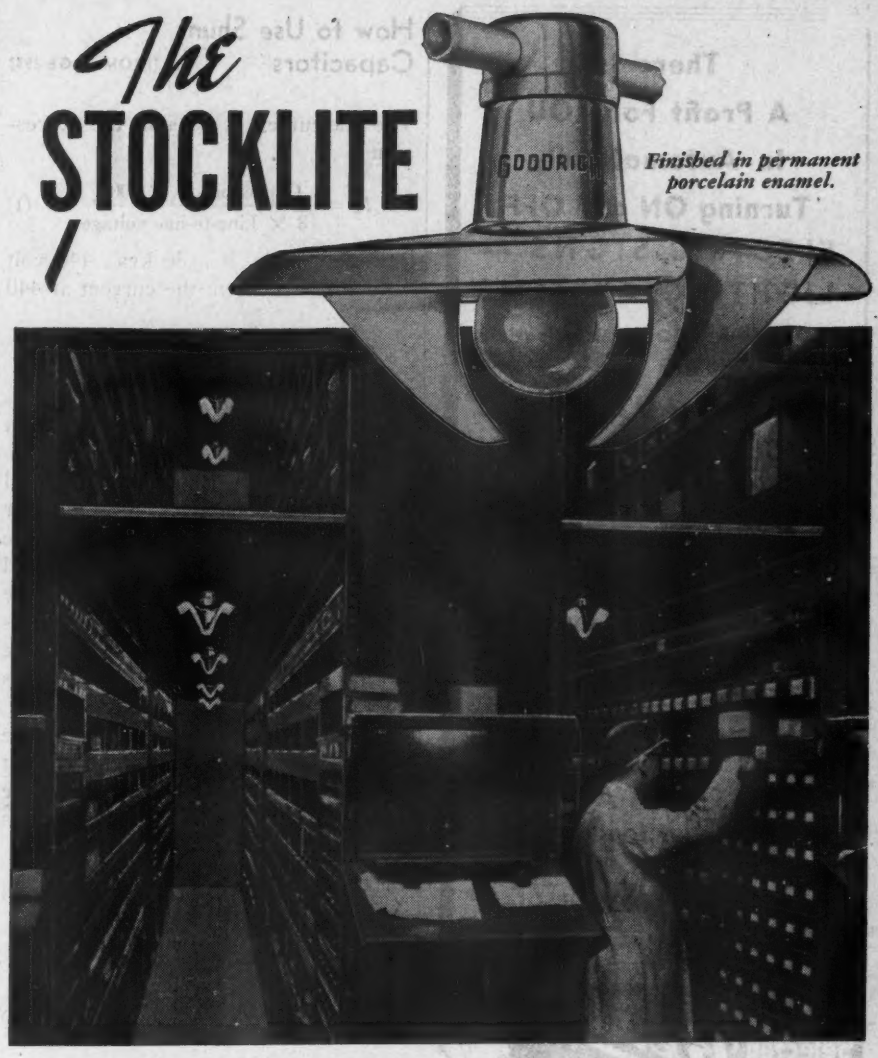
Methods of Determining Over-voltages

Unless over-voltages due to self-excitation are measured by actual test, the saturation curve of the machine in question must be used. The manufacturer can supply a curve for the particular type and rating of motor being investigated, but these curves will not usually be extended to a high enough voltage. If this be the case, the only solution is to place the motor and capacitor under test. Individual motors will vary from the saturation curve due to variations in the magnetic circuit, but typical voltages can be obtained. There are two methods available which are based on the previous discussion of the "Principle of Self-Excitation," and both amount to performing the same operation; one by graphical means, and the other by analytical means. A typical 50 hp., 440 volt, 3-phase, 60 cycle, 570 rpm., type CS Westinghouse induction motor was chosen and the self-excitation voltages determined. A discussion of the analysis and the results will suffice to illustrate the methods.

The no-load saturation curve of the motor is shown in Fig. 4. The voltage attained by self-excitation is determined by the intersection of the volt-ampere characteristic of the capacitor and the saturation curve. The volt-ampere characteristic is a straight line through the origin and only one other point need be determined. This point should be taken at normal rated voltage and rated kva. of the capacitor.

[Continued on page 194]

The STOCKLITE



Finished in permanent porcelain enamel.

illuminates stock bin interiors, too!

Uniform illumination of stockroom shelves—from top to bottom row—is only a part of the Stocklite's job. This novel reflector also puts light into bin interiors.

It does this because its ingenious design utilizes the lamp's full efficiency—shields aisles from glare—directs more light to the sides—builds up intensities where light is needed. That's why the Stocklite is preferred by leading industries everywhere.

There's no time like the present to invest in better stockroom illumination. Once installed, the Stocklite is there to stay. Finished in permanent porcelain enamel, it is ready to assure eye comfort, convenience and better stockroom service for years to come.

This illustrated bulletin describes the many important advantages of proper stockroom illumination. Ask for your copy of Bulletin 91.

Sold through electrical wholesalers

HIGHLITE STOCKLITE REFLECTO FLOODLIGHT RLM DOME

GOODRICH
ELECTRIC COMPANY
4600 BELLE PLAINE AVENUE, CHICAGO 41, ILLINOIS

There Is
A Profit For YOU
In Automatically
Turning ON and OFF
ELECTRIC SIGNS —
LIGHTING SYSTEMS
And Dozens of Other Applications
with the
2200-Watt AUTOMATIC
Self-Starting TIME SWITCH
Single Pole—MODEL 120
$12.00
Why buy LESS
when you get the MOST
in AUTOMATICS
Prices Subject to Usual Discount & Terms
Write for Information
AUTOMATIC
Electric Manufacturing Co.
TIME SWITCHES—FLASHERS
MANKATO • MINNESOTA

We've Selected Revere

That's The Inevitable Decision OF ENGINEERS WHO STUDY REVERE DESIGN AND WORKMANSHIP.

750 to 1500 Watt Enclosed Flood.

High Bay Units for every requirement—in steel or alzak aluminum.

75 to 1000 watt enclosed and open type flood.

You're money ahead when you install REVERE Units . . . saving time in installation with no come-backs. Complete line for Airport, Marine, Industrial and Sports Lighting. *Write for particulars.*

Famous Hinged Floodlight Pole which eliminates hazardous pole climbing.

REVERE ELECTRIC MFG. CO.
Originators of the Hinged Floodlight Pole
INDOOR and OUTDOOR LIGHTING EQUIPMENT of EVERY DESCRIPTION

How to Use Shunt Capacitors

[FROM PAGE 193]

The line current is given by the expression

$$I_L = \frac{\text{Capacitor kva} \times 1000}{\sqrt{3} \times \text{Line-to-line voltage}} \quad (1)$$

For example, if a 30 kva., 440 volt capacitor is chosen, the current at 440 volts is

$$I_L = \frac{30 \times 1000}{\sqrt{3} \times 440} = 39.4 \text{ amperes.}$$

This point is plotted in Fig. 4 and a straight line drawn through the origin. Hence, a 30 kva. capacitor connected to the terminals gives 575 volts or 131 percent of normal line-to-line voltage. Characteristics are also plotted for other sizes of capacitors, and the data summarized in Table 1. A capacitor (50 kva.) equal numerically to the hp. rating of the motor gives 697 volts or 159 percent of normal.

In the second method the capacitive reactance X_c is found and different voltages chosen on the saturation curve until $(X_m + X)$ in Fig. 1(b) is equal to X_c. From Fig. 1(b).

$$\frac{e}{i_m} = X_c = (X_m + X) \quad (2)$$

where e is line-to-neutral voltage.

$$X_c = \frac{(\text{Capacitor rated line-to-line Voltage})^2}{\text{Capacitor kva} \times 1000} \quad (3)$$

The voltage due to self-excitation for a given capacitor is that voltage which, when divided by the corresponding magnetizing current i_m, gives $(X_m + X)$ in Eq. (2) equal to X_c determined in Eq. (3).

Using the 50 hp. motor to illustrate, for a 30 kva. capacitor

$$X_c = 6.45 \text{ ohms per phase}$$

For terminal voltage of 575 volts, line-to-line, the magnetizing current is 51.5 amperes, as shown in the saturation curve. Then $(X_m + X) =$

$$\frac{e}{i_m} = \frac{575}{3 \times 51.5} =$$

6.45 ohms per phase. Carrying out this procedure for different sizes of capacitors will give the same voltage obtained by drawing the capacitor volt-ampere characteristics.

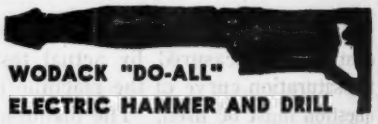
A third method of finding these voltages is to actually place the motor under test with various sizes of capacitors connected to the terminals. A voltmeter connected across the terminals will give all the information needed. Simply running the motor at rated speed, disconnecting it from the line and reading the voltmeter will give the voltage caused by self-excitation.

WHERE TO BUY
Equipment, Materials and Supplies for Electrical Construction — Maintenance — Repairs

TORK

TURN ANYTHING ELECTRICAL ON & OFF REGULARLY
The TORK CLOCK CO., Inc.
MOUNT VERNON, NEW YORK

DRILL CONCRETE THE EASY WAY



WODACK "DO-ALL"
ELECTRIC HAMMER AND DRILL
Saves time and labor installing expansion anchors. Two motions—reciprocal for hammer drilling—rotary for twist drilling. Drills masonry to 1⅝" dia., metal ⅝". Easy to maintain. Universal motor, runs direct from lamp socket. Weighs 15 lbs. Star drills in 17 diameters. Also chisels, bull points, etc. Ask for bulletin.
Wodack Electric Tool Corporation
4628 W. Huron St. Chicago 44, Ill.
Telephone AUstin 9866

ALLEN FLUX
for SODERING
Silver Soldering
WELDING
L. B. ALLEN CO., INC.
6715 Bryn Mawr Chicago, 31, Ill.

?
Find what you are looking for? If the advertising in this issue does not supply the information wanted, of products or services, write
ELECTRICAL CONTRACTING
330 W. 42d St., New York

Tests were made on the 50 hp. motor, and the results are shown in Table 1 and by the crosses in Fig. 4.

Amount of Capacitor KVA. Necessary for Power Factor Improvement

In order to determine the value of capacitor kva. necessary to correct the power factor of an induction motor it is only necessary to know the present load and power factor. Assuming a general case in which:

$(\text{kva.})_L$ = Present kva. of load represented by the induction motor
$\cos \theta_L$ = Present power factor
$\cos \theta_2$ = Desired power factor.

The solution is as follows:

Present kw. load = $(\text{kw.})_L = (\text{kva.})_L \times (\cos \theta_L)$

Present reactive kva. = $(\text{rkva.})_L = \sqrt{(\text{kva.})^2_L - (\text{kw.})^2_L}$

Kva. at desired power factor = $(\text{kva.})_{L2} = \dfrac{(\text{kw.})_L}{\cos \theta_2}$

Reactive kva. at desired power factor = $(\text{rkva.})_{L2} = \sqrt{(\text{kva.})^2_{L2} - (\text{kw.})^2_L}$

Corrective kva. needed = $(\text{kva.})_c = (\text{rkva.})_L - (\text{rkva.})_{L2}$

A standard capacitor kva. rating near the value of $(\text{kva.})_c$ should be chosen.

As an example, assume that the 50 hp. motor used above operates at full load and that it is desired to correct the power factor to 95 percent. The load represented by the induction motor is 42.2 kw. at 83 percent power factor.

Present kw. load = 42.2 kw.
Present power factor = 83 percent

$$\text{Present kva.} = \frac{42.2}{.83} = 50.9 \text{ kva.}$$

$$\text{Present reactive kva.} = \sqrt{(50.9)^2 - (42.2)^2} = 28.5 \text{ kva.}$$

$$\text{kva. at desired power factor} = \frac{42.2}{.95} = 44.4 \text{ kva.}$$

$$\text{Reactive kva. at desired power factor} = \sqrt{(44.4)^2 - (42.2)^2} = 13.7 \text{ kva.}$$

Capacitor kva. = 28.5 − 13.7 = 14.8 kva.

The correct capacitor would be a 460-volt, 15 kva. unit. When operated at 440 volts this capacitor has a reactive kva. of 13.7 kva., and will correct the power factor to 95.3 percent.

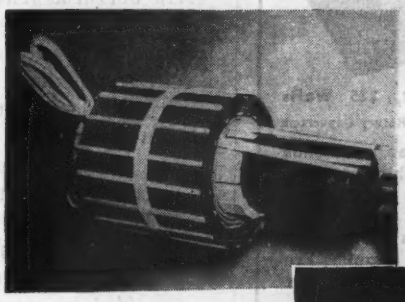
It is usually sufficient to correct the power factor at full load to approximately 95 percent. Insofar as induction motors are concerned this will give a reasonable correction at lighter loads. In the above example, the power factor at one-half load is 66 percent, and the 15 kva. capacitor will correct this to 90 percent. A capacitor chosen on this basis will also be smaller than that necessary to produce excessive voltages due to self-excitation for most motors. If correction to a higher value of power factor is made, possibility of excessive overvoltages should be checked by one of the methods described.

NO. 3 OF A SERIES ON THE *Service Superiority* OF

DAVIS TRANSFORMERS

Safety

Safety to life and property is the first consideration in the design and construction of Davis Transformers. Davis Transformers have been manufactured since 1935 and have won a name for themselves because of their in-built safety, reliability and efficiency. Into their production we put the practical experience gained thru years of repairing and rebuilding Transformers of EVERY MAKE, size and voltage. This experience enables us to SAFEGUARD Davis Transformers at those points where failures usually occur.



Winding DAVIS 37½ KVA, 2400-120/240 volt transformer

The points at which the insulation is most important to the lives and safety of those who must or may come in contact with the equipment are between high voltage and low voltage windings and between windings and case.

The insulation at these points consists of a pad of a plurality of kinds of insulating materials, each of which has been carefully selected for its ability to perform a particular function.

NOTE QUANTITIES OF INSULATION

TRANSFORMER *Service* FOR YOUR BENEFIT

- For years we have been "transformer repair headquarters" for leading utilities and industrial companies. We offer complete repair and rebuilding service. All work guaranteed same as that of original manufacturer. A large stock of used transformers for sales — similarly guaranteed. Write us.

DAVIS TRANSFORMER COMPANY

DAVIS TRANSFORMER CO.
Phone 177 CONCORD, N. H.
and
STOCKWELL TRANSFORMER CORP.
CONCORD, N.H.—Phone 177 AKRON, OHIO—Phone Jefferson 4179
Manufacturers of Oil Cooled, Dry Type, Power and Distribution Transformers
Also All Types of Specialty Transformers Regardless of Size

NEMA

Contact Our Nearest Agent

THE BRADLEY COMPANY
508 Bond Building
Washington, D. C.
Tel. Rep. 4483

THE BRADLEY COMPANY
101 North 33rd Street
Philadelphia, Pa.
Tel. Evergreen 1750

JOHN W. CRAWBUCK
Empire Building
Pittsburgh, Pa.
Tel. Atlantic 6348

T. B. DALLY
26 Journal Square
Jersey City, N. J.
Tel. Journal Square 2-3587

HOWARD B. JOHNSON
53 West Jackson Blvd.
Chicago, Illinois
Tel. Harrison 0050

BRADLEY AND WILLIAMS
409 University Bldg.
Syracuse, New York
Tel. 3-2368

SWANK-LIDDLE, Inc.
18925 Grand River Ave.
Detroit 23, Michigan
Tel. Vermont 7-5310

WILLIAM G. MEROWIT
436 Niagara Street
Buffalo, New York
Tel. Madison 1233

L. C. R. SALES
Box 1191
Austin, Texas
Austin 8-4511

ARTHUR E. OLSON
1119 Lane Place
St. Paul 6, Minnesota

ELECTRICAL SERVICE & SALES, Inc.
47-51 North Second Street
New Bedford, Massachusetts
Tel. 6-8578

F. M. NICHOLAS COMPANY
112 Harrison Street
San Francisco 3, California
Tel. Underhill 4830

110-Volts A. C. from Direct Current

with KATOLIGHT ROTARY KONVERTERS Change 32, 110 or 220 volts D.C. to standard 110-volt, 60-cycle A.C. for operating radios, electronic & sound apparatus, electric signs, A.C. appliances, etc.

KATO ROTARY KONVERTER, 225 Watts

Pioneers in the Building of Small Rotary Converters

At present Kato's entire production must be directed to furnishing converters on priority orders.
Also manufacturers of A.C. and D.C. generators ranging from 350 watts through 25 K.W.; power plants; Frequency Changers; and Motor Generator Sets.

KATO ENGINEERING CO.

649 N. Front St., Mankato, Minnesota

A SPECIAL MESSAGE
About Infra-Red Ray Drying

To Those Whose Production Requirements Necessitate the Use of Lacquers, Synthetics, Paints and other Finishes

Use Nalco Infra-red Ray Drying Equipment to solve a wide variety of problems . . . spot drying and baking of various finishes and dopes . . . quick drying of varnishes and impregnating materials for motor windings and electrical and mechanical parts of all types.

NALCO DRITHERM LAMPS

- Will Cut drying costs and time.
- Eliminate "warm up" time.
- Require no enclosures nor ovens.
- Use a minimum of space.

Left — Nalco 5-light portable adjustable unit.

NORTH AMERICAN Electric Lamp Co.

1044 Tyler St. St. Louis 6, Missouri

Lighting Techniques as Applied to Hospitals

[FROM PAGE 69]

tem to provide the shadowless high intensity light on the operating table. Others prefer a portable type unit, or an adjustable overhead type unit. For these reasons the operating room lighting system should be discussed with the surgeon in charge when the lighting is being planned, and approval of the proposed system obtained from him.

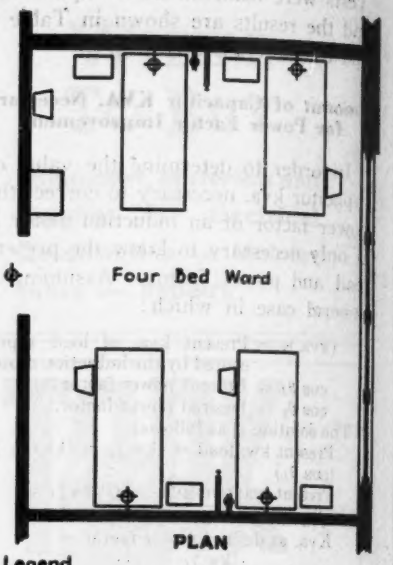
Operating room lighting may be satisfactorily provided by either of three systems, as follows:

1. *An overhead lens system* built into the ceiling, where general room illumination is provided by wide spread diffuse type lenses and a high intensity edgeless spot of illumination is provided on the operating table by concentrating type lenses in which the beam is directed to the operating table.
2. *An overhead ceiling mounted system* where general illumination is provided by means of flush or surface mounted shielded lighting units, and a high intensity of illumination is provided for the operating table by a suspended adjustable fixture which will provide a converging beam of light.
3. *A combination system* where general illumination is provided by means of flush or surface mounted shielded lighting units, and where localized lighting for the operating table is provided by an adjustable portable floor lamp.

Any system of operating room lighting which varies appreciably from either of the above described systems should be analyzed very carefully, since these three systems have been evolved after many tests and years of satisfactory use.

A separate emergency lighting system, powered by a storage battery, should be provided for use in case of power failure. The storage battery should be of sufficient capacity to light the operating room for an adequate period of time to complete an operation. The emergency circuit should be arranged for automatic operation in case of a power failure in the regular lighting system.

All glass used in lighting units for control of the light should have the property of screening out direct heat and infra-red radiation. It should also be shatterproof. Such glass will also color correct the light rays and produce a whiter light.



***LIGHTING IN WARDS** at Norfolk County Hospital is from adjustable over bed brackets only. Semi-private and private rooms have the same lighting and electrical facilities as shown for two beds in a four-bed ward.*

In an overhead lens system, wiring arrangement should provide for special switching arrangement to enable the best lighting and comfort conditions for each operating position. Single lamp spotlights, whether of the ceiling mounted or portable type, should be provided with a double-filament lamp, wired to an automatic switch which will afford protection against lamp failure.

For minor and special purpose operating rooms, the same principles of lighting discussed above apply, except that the systems used may be less elaborate, depending upon the criticalness of the seeing problem involved. Included in this group are dental surgery, delivery room, cystoscopic room, plaster room, etc.

In the operating suite are other rooms, such as sterilizing, clean-up, anesthesia storage and similar areas which may be classed as service areas. Standard explosion-proof type fixtures may be used for the anesthesia storage, and standard direct-indirect type commercial fixtures are suitable for the other rooms.

Nursing

The lighting for private rooms and wards should be flexible to permit a variety of intensities, and lighting effects. The trend is toward a cheerful, homelike atmosphere, particularly in

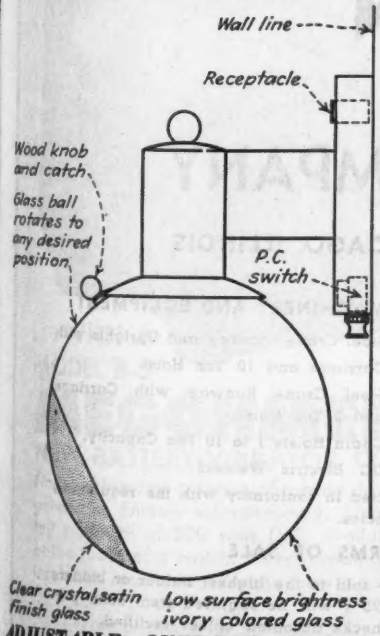
private and semi-private rooms. Usually the patient will be annoyed by light until he reaches a convalescing stage. Adequate light must be provided to permit the nurse or doctor to enter the room safely for observation of the patient. Higher intensities must be available for examinations, treatments, and for feeding. When the patient is able to read, properly diffused light for this purpose must be available. For semi-private rooms and for wards, the units must be adequately shielded to prevent glare to other patients.

Center outlet overhead lighting units in sick rooms are in the patient's normal line of vision, and are not recommended except when they are of the indirect type and are used to provide general illumination for use by the doctor or nurse. When such units are used, separate wall brackets or floor portable lamps are necessary to provide satisfactory illumination to enable the patient to read comfortably.

Combination type direct-indirect wall brackets satisfactorily meet the lighting requirements for the sick room. These brackets are mounted approximately seven feet from the floor over the head of the bed. Two pull cord switches are used with each bracket, one to control the indirect lighting for general room illumination, and the other to control the direct lighting for the patient's use in reading.

A flush mounted wall night-light should be used in the sick room or ward, one for each two beds, in

[Continued on page 198]



ADJUSTABLE OVER-BED BRACKETS provide indirect lighting for diffused general illumination, or direct lighting for reading or examination, by rotating the glass globe. Used over all beds in Norfolk County Hospital.

for today and for tomorrow.....

QUAD

Lighting UNITS

RLM Heavy Threaded Deep Bowl Reflector and Socket Hoods

RLM Threaded Dome Reflector

OVER 53% of all jobs done by contractors involve the installation of lighting fixtures. Make your share of these jobs pay you by installing QUAD units. They are modern, easily wired and installed, quickly detachable for cleaning, and highly flexible in design. All units are weatherproof and porcelain finish is permanent. You install them and your job is finished—result is more time for more jobs. For the proper unit for general or specialized installations — indoor or out — make your selection from the very complete QUAD line.

QUADRANGLE MFG. COMPANY

Mfgrs. of Incandescent and Fluorescent Lighting Equipment

32 SO. PEORIA ST. CHICAGO, ILL.

SEARCHLIGHT SECTION

POSITION VACANT

ESTIMATOR-ENGINEER: Age 26 to 36 possessing supervisory and sales ability for well established electrical contracting firm; Chicago-Kansas City district; to estimate wiring jobs ranging $5,000 to $500,000; steady postwar position; give age, experience, education, salary expected, snapshot and when available. P-333, Electrical Contracting, 520 N. Michigan Ave., Chicago 11, Ill.

REPRESENTATIVES AVAILABLE

WANTED: Electrical Manufacturers of electrical equipment, supplies, and appliances. Large waiting market now and post-war. Contact immediately. RA-334, Electrical Contracting, 68 Post Street, San Francisco 4, Cal.

MANUFACTURERS, let us represent you in the Southwest. Fluorescent and general electrical products outlets. Established 1938. Goodwill Supply, Box 2242, Ft. Worth, Texas.

MAKE EXTRA MONEY

simply—easily—IN YOUR SPARE TIME

If you work with other industrial men, you can earn profits in spare time by recommending McGraw-Hill technical books to fellow workers. Write for details to

E. KASK
Dept.C, 330 W.42nd St., New York City 18

America's Best Assortment
ELECTRIC MOTORS
GENERATORS
TRANSFORMERS
from 1 H.P. to 1000 H.P. A.C.
25-50-60 cycle D.C., all voltages
ELECTRIC EQUIPMENT COMPANY
63 CURLEW ST., ROCHESTER, N. Y.
GLENWOOD 6783, P.O. BOX 51

Lighting Techniques as Applied to Hospitals

[FROM PAGE 197]

combination with an overhead or wall bracket general lighting system. Nightlights should be switch controlled from the doorway.

Service Areas

The lighting of service areas in a hospital, such as the kitchen, dining room, dishwashing room, laundry, lecture and class rooms, storage areas, boiler room, etc. do not present any special problems. They should be treated the same as similar areas in any other type building. Fifteen to twenty-five foot-candles of well diffused properly shielded direct or semi-direct lighting is generally satisfactory.

Out-Patient Department

Out-patient departments may vary greatly. They are commonly regarded as entirely separate from the normal in-patient service, but often use the facilities of the hospital proper. The usual out-patient department will consist of a waiting room, admitting office, appointment and/or cashier's desk, and clinical section with examining rooms, dressing rooms, treatment rooms and

SEARCHLIGHT SECTION

FOR SALE

250 Cord Sets, Belden Plug, 11 Ft. Rubber Cable, Asbestos inside, 2 wire, No. 14 $2.00
600 pieces Rubber Cable, 15 ft. lengths, 2 wire, No. 12 $2.25
100 Transformers G.E. 50 Watt, 110 volts to 6 volts $2.75
600 Belden Rubber Plugs with 15 in. Rubber Cord attached 25c
800 ft. used (like new) No. 4—3 wire Super Rubber Cable 25, 50, 75, and 100 ft. lengths $1.00 per ft.
28 ¼ HP 860 R.P.M. 3 ph. West. with Magnetic Brake 220 volt, 60 cy., type. CSA $24.
18 ⅛ HP 860 R.P.M. 3 ph. G.E. enclosed Motor, type K.T. 220 volt 60 cy. $18.00
12 1½ HP Louis Allis 3600 R.P.M., B.B. $40.00.
600 H & H Heater Switches high, medium, low, off 20 amps at 110 volts 60c.

WANTED

32 volt motors.

Clarke & Henke Electric Company
436 W. Juneau, Milwaukee 3, Wis.

UNIVERSAL TOOLS

Channel-lock pliers, end-tap pliers, Crescent wrenches, vice grips, open and box wrenches, sockets, needle nose, side cutter diagonal pliers, screw extractors, screw drivers, wheel pullers. Remember: we have it, can get it, or it is not made. Prompt shipment order today. COD. Catalogue free.

DEALERS TOOL SUPPLY
Dept. EC 1527 Grand Av. Kansas City, Mo.

PRICED For QUICK SALE

34—A.C. combination Watthour and Demand Meters; 115 volts, 60 cycle, 10, 25 and 50 amperes. Gen. Electric types I-16 and IM-16.

F. MAYER
608 South Dearborn St., Chicago 5, Illinois

By Order of the Board of Directors We Will On

TUESDAY AND WEDNESDAY, MARCH 20TH AND 21ST, 1945

Commencing Each Day at 10:30 A. M., C. W. T. Sell At Public

AUCTION

The Inventory and Equipment of the
MOTOR DIVISION
of

GREGORY ELECTRIC COMPANY

at

2630-32 SOUTH WABASH AVENUE **CHICAGO, ILLINOIS**

Consisting of:

800—Used AC Motors 1 HP to 200 HP Squirrel Cage and Slip Ring in General Electric, Westinghouse, Allis Chalmers and other Makes.
300—Used DC Motors 1 HP to 150 HP 220 Volt and 110 Volt, Westinghouse S.K. General Electric C.D. and other Makes.
3—AC Alternators 100 KVA to 150 KVA.
5—Motor Generator Sets from 5 KW to 75 KW.
200—New Westinghouse Magnetic Starters.
500—Safety Switches 2 and 3 Pole AC and DC.
1000—AC and DC Starters from 1 HP to 200 HP.
4000—Motor Bases, Pulleys and Rails.
A large selection of Oil Circuit Breakers, Switch Board Panels, Current Transformers, Drum Controls, Grids, Meters, Speed Reducers, Etc.

INSPECTION: Commencing March 15th, 1945, Daily, except Sunday.

The Gregory Electric Company will continue its Transformer Business at 2535 South State Street, Chicago. This Sale will in no way affect the transformer department.

MACHINERY AND EQUIPMENT

1—Steel Crane Runway and Uprights with Carriage and 10 Ton Hoist.
1—Steel Crane Runway with Carriage and 2 Ton Hoist.
8—Chain Hoists 1 to 10 Ton Capacity.
3—DC Electric Welders.

This Sale will be conducted in conformity with the regulations of all Government Agencies.

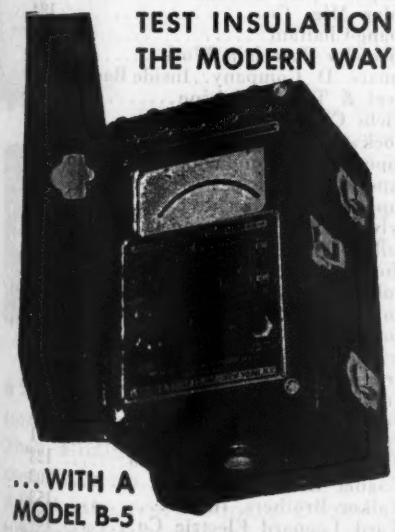
TERMS OF SALE

All of the above will be sold to the highest bidder or bidders for cash. A deposit of 25% will be required from each purchaser. Positively no checks accepted unless certified. For descriptive circular, write to

1894 **SAMUEL L. WINTERNITZ & COMPANY** 1945
LIQUIDATORS AND AUCTIONEERS
First National Bank Bldg. Phone State 5908 CHICAGO 3, ILLINOIS

specialty rooms, as required. It is considered that comments made on the lighting problems of the hospital proper will apply to the various similar areas of the out-patient department.

Details for illustrations used with this article were taken from two typical emergency construction hospital projects approved by the Hospital Facility Section, U. S. Public Health Service, and built under provisions of the Lanham Act. These are the Norfolk County Hospital, Portsmouth, Virginia, and De Paul Hospital, Norfolk, Virginia. Rigid construction limitations of WPB had to be observed, and products used, such as the lighting fixtures, were manufactured under the restrictions of controlling limitation and conservation orders of WPB. James R. Edmunds, Jr., Baltimore, Maryland, was the architect for these two projects. On the Norfolk County Hospital, others responsible for the electrical and lighting plans and installation were: Henry Adams, Inc., Baltimore, Maryland, mechanical engineers; Chester W. Snyder and Associates, Inc., Baltimore, Maryland, lighting; Mechanical Engineering Corporation, Norfolk, Virginia, electrical contractors.



TEST INSULATION THE MODERN WAY

...WITH A MODEL B-5

MEGOHMER

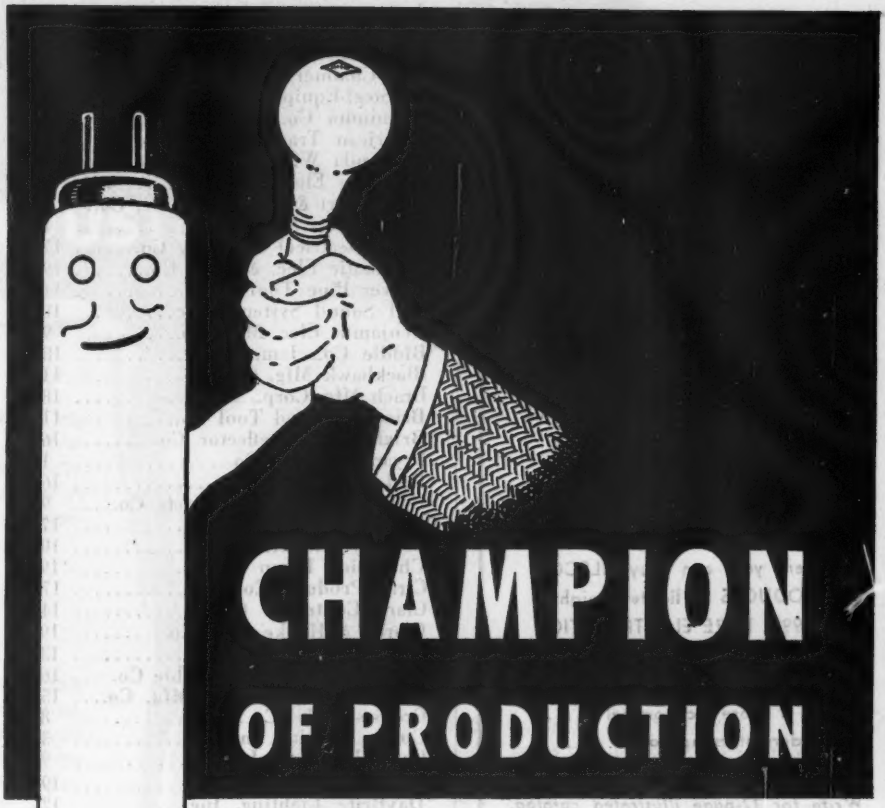
NEW BATTERY-VIBRATOR TYPE

No more tiresome cranking of a hand-driven generator. Entirely self-contained. Steady test potential of 500 volts D.C. available at the touch of a switch. Direct reading in insulation resistance. Various new models and ranges.

Write or phone for Bulletin 430

HERMAN H. Sticht COMPANY, INC.

27 PARK PLACE NEW YORK, N. Y.



CHAMPION OF PRODUCTION

If you're the production champion of your industry, or aspire to be, you know what good lighting, and good lamps, mean to quality, quantity, safety and true economy of production.

CHAMPION *Fluorescent* and **Incandescent** Lamps are designed, manufactured and tested to be worthy of the responsibility for dependable, low cost industrial lighting.

CHAMPION lighting engineers are at your service, without charge, to provide competent and unbiased assistance on your industrial lighting problems.

CHAMPION industrial distributors combine with Champion's specialized industrial production set-up to supply your lamp needs with the utmost efficiency at lowest cost lighting effectiveness and lamp performance taken into account.

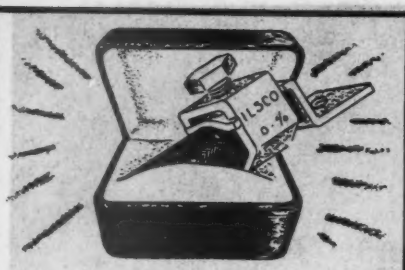
Look for the Diamond mark on *Fluorescent* and **Incandescent** lamps. It's the mark of an industrial production CHAMPION.

CHAMPION ◇W 40 DAYLIGHT

CHAMPION LAMP WORKS

Lynn, Massachusetts

A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO.



ILSCO LUGS
AND CONNECTORS

Deserve a Jewel Box . . . But

Why pay more for the box than the contents? Or, why pay for the extra weight of cast lugs of poor conductivity when you can buy ILSCO PRODUCTS of lighter weight, 99.99% PURE ELECTROLYTIC COPPER AND 100% CONDUCTIVITY! More efficient . . . more economical . . . Underwriters approved . . .

Write for 32-page illustrated catalog.

ILSCO COPPER TUBE & PRODUCTS, Inc.
CINCINNATI, OHIO

BETTER LIGHTING
IS A NATURAL
RESULT WITH
MULTI
Reflectors

• All time favorites . . . that's the way contractors feel about the MULTI line. They have good reason too—MULTI is complete—they can get the proper unit for any type of installation—maintenance is simple—no after worries. Here is your modern, flexible line of Reflectors that gives long-time service and better lighting.

• Send for Complete Catalog

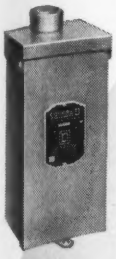
MULTI
ELECTRICAL MANUFACTURING CO.
1840 W. 14th ST., CHICAGO, ILL.

ALPHABETICAL INDEX TO ADVERTISERS

*Adam Electric Co., Frank 151
*Aerovox Corporation 94
*Allen-Bradley Co. 117, 118
*Allen Co., Inc., L. B. 194
*Allis-Chalmers Mfg. Co. 5
*All-Steel-Equip. Co. 36
Aluminum Co. of America 157
*American Transformer Co. 21
*Anaconda Wire & Cable Co. 56
*Appleton Electric Co. 2
Arrow-Hart & Hegeman Elec. Co. 40
*Austin Co., M. B. 44
*Auth Electrical Specialty Co. 171
Automatic Elec. & Mfg. Co. 194
*Beaver Pipe Tools, Inc. 112
Bell Sound Systems, Inc. 182
*Benjamin Elec. Mfg. Co. 96
*Biddle Co., James G. 181
Blackhawk Mfg. Co. 114
Brach Mfg. Corp., L. S. 188
*Briegel Method Tool Co. 112
*Bright Light Reflector Co. 163
Bryant Electric Co. 16
*Buffalo Forge Co. 164
*BullDog Electric Products Co. 91
*Burke Electric Co. 178
Century Electric Co. 101
*Champion Lamp Works 199
Circo Products Co. 175
Clark Controller Co. 143
Clarke & Henke Elec. Co. 198
*Collyer Ins. Wire Co. 135
Crescent Ins. Wire & Cable Co. 162
*Crocker-Wheeler Elec. Mfg. Co. 159
Crouse-Hinds Co. 85
Curtis Lighting, Inc. 35
Cutler-Hammer, Inc. 93
Davis Transformer Co. 195
*DayBrite Lighting, Inc. 127
Dealers Tool Supply 198
Dolph Co., John C. 122
Economy Fuse & Mfg. Co. 22
*Efficiency Elec. & Mfg. Co. 115
Electric Equipment Co. 198
*Fairbanks, Morse & Co. 109
Federal Electric Co. 30, 31
Federal Electric Products Co. 158
Fostoria Pressed Steel Corp. 154, 155
Frink Corp. 8
*Fullman Mfg. Co. 173
*Gedney Electric Co. 192
General Cable Corp. 124, 125
*General Electric Co. (Bridgeport) Back Cover, 148, 177
*General Electric Co. (Nela Park) 132, 133
*General Electric Co. (Schenectady) Inside Front Cover, 6, 7, 9
General Luminescent Corp. 174
Goodrich Electric Co. 193
*Graybar Electric Co. 58
*Greenlee Tool Company 119
*Hazard Ins. Wire Works Div. 137
Holtzer-Cabot Electric Company 164
*Hullhorst Micro Tool Co. 168
*Ideal Commutator Dresser Co. 54
*Ilg Electric Vent. Co. 95
*Illinois Electric Porcelain Co. 38
*Ilsco Copper Tube & Products Co. 200
*Insulation & Wires, Inc. 111, 129, 168, 180
*Irvington Varnish & Ins. Co. 39
*Jefferson Electric Co. 145
Jenkins Brothers 23
*Johns-Manville 32
*Johnson Bronze Co. 115
Joleco Corporation 15
Kask, E. 198
*Kato Engineering Co. 196
Kinney Elec. Mfg. Co. 179
*Klein & Sons, Mathias 169
Kondu Corp. 186
*Krueger & Hudepohl 188
Laduby Company 176
Lau Blower Co. 37
*Leader Elec. Mfg. Corp. 51
Leland Electric Co., The 121
*Lighting Products Inc. 161
Master Electric Co. 17
Master Vibrator Co. 170
Mayer, F. 198
*McGill Mfg. Co. 128
*Mercoid Corp. 184
*Metropolitan Device Corp. 1
Miller Co. 24
Mines Equipment Co. 190
*Minerallac Electric Co. 184
Minnesota Mining Co. 160
Mitchell Mfg. Co. 149
Monarch Fuse Co. 92
Multi Electric Mfg. Co. 200
*M & W Electric Mfg. Co. 114
National Elec. Products Corp. 47
*North American Electric Lamp Co. 196
*Norton Electrical Instrument Co. 172
*Ohio Carbon Co. 13
*Okonite Co. 137
*Onan & Sons, D. W. 174
Overbagh & Ayres Mfg. Co. 187
*Owens-Corning Fiberglas Corp. 20
*O. Z. Electrical Mfg. Corp. 189
*Paine Co., The 114
Paragon Electric Co. 183
*Paranite Wire & Cable Corp. 27
Pass & Seymour, Inc. 188
*Penn-Union Elec. Corp. 166
Porcelain Group 123
*Porcelain Products, Inc. 123, 167
Pryne & Co. 166
Pyle-National Co., The 104
Quadrangle Mfg. Corp. 197
Radio Corp. of America 48, 139
Reading Electric Co., Inc. 182
*Reliance Automatic Lighting, Inc. 178
Republic Steel Corp. 106, 107
*Revere Elec. Mfg. Co. 194
*Ridge Tool Co. 46
*RLM Standards Inst., Inc. 45
Robertson Co., H. H. 4
*Roebling's Sons Co., John A. 18, 19
Royal Electric Co. 156
*Rusgreen Mfg. Co. 190
*Russell & Stoll Co. 191
*Sangamo Electric Co. 14
*Sherman Mfg. Co., H. B. 165
Simplex Wire & Cable Co. 147
*Solar Mfg. Co. 184
*Spang-Chalfant 29
*Specialty Porcelain Works 123
Square D Company ..... Inside Back Cover
Steel & Tubes Division 106, 107
*Sticht Co., Herman H. 199
Stockwell Transformer Corp. 195
*Superior Carbon Prod. Co., Inc. 113
Superior Ins. Tape Co. 25
Superior Instrument Corp. 192
*Sylvania Electric Products, Inc. 83
Talk-A-Phone Mfg. Co. 170
Thomas & Betts 33
*Toledo Pipe Threading Mach. Co. 10
*Toledo Standard Commutator Co. 168
*Tork Clock Co. 194
Trico Fuse Mfg. Co. 113
*Trumbull Electric Mfg. Co. 87
Union Insulating Company 172
*Unistrut Products Co. 41
*United States Rubber Co. 49, 131
*Universal Clay Products Co. 123
Wagner Electric Corp. 103
Walker Brothers, Inc. 153
*Ward Leonard Electric Co. 180
*Ware Brothers, Inc. 116
*Webster Electric Co. 12
Western Electric Co. 190
*Westinghouse Elec. & Mfg. Co. (East Pittsburgh) 140, 141
*Westinghouse Elec. & Mfg. Co. (Fan Division) 26
*Westinghouse Elec. & Mfg. Co. (Lamp Div.) 42, 43
*Westinghouse Elec. & Mfg. Co. (Pittsburgh) 88, 89
*Weston Electrical Instr. Corp. 105
*Wheeler Reflector Co. 185
Winternitz Co., Samuel L. 198
Wiremold Company 34
Wodack Elec. Tool Corp. 194
Youngstown Sheet & Tube Co. 11

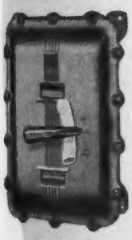
*These companies have included Briefalogs, containing additional buying information on their products, in the 1945 edition of the Electrical Buyers' Reference.

THERE IS A SQUARE D *Circuit Breaker* FOR EVERY TYPE OF INDUSTRIAL APPLICATION

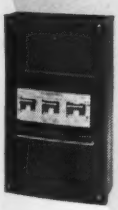


Rain-tight Multi-breakers with a variety of circuit arrangements for such outdoor applications as lights, signs, etc. Also Multi-breakers and circuit breakers in weather and dust-tight and explosion-resisting enclosures.

Industrial Multi-breakers are available in capacities from 15 to 100 amperes, with 2 or 3 poles. Quick make, quick break with dust-resisting sheet steel enclosures; also, explosion-resisting types. Front operated with trip indication.



Weatherproof, Dust-tight and Explosion-Resisting Circuit Breakers are furnished in cast iron enclosures with gray enamel finish. Standard conduit openings in the ends. Capacities—15 to 600 amperes up to 575 Volts.



Multi-breaker Type M Load Centers with 50 ampere frame breakers for applications involving 120-240 volt AC circuits. Available with varied number of single and double pole breakers of 15-20-25-35 and 50 ampere ratings. 100 ampere bussed mains available if required. Choice of surface or flush mounting devices for indoor installations and raintight boxes for outdoor applications.

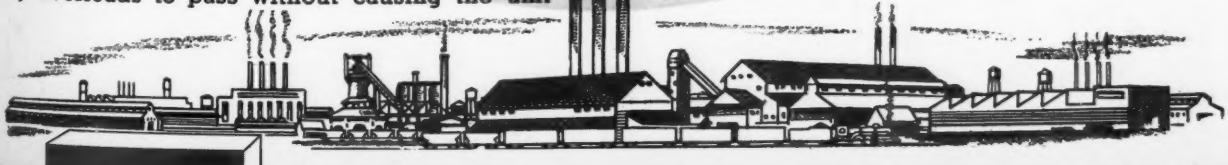
MO Multi-breaker for use on small machines such as drill presses, grinders, riveters, staplers, saws, beaters, etc. Available in single and double pole or for 2 and 3-wire systems. 15, 20 and 25 amperes. Price is comparable to Type D switches.

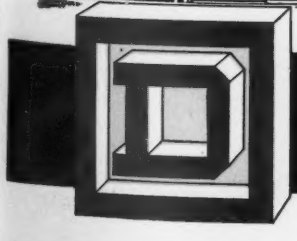
Industrial Circuit Breakers in standard sheet steel enclosures are available in capacities from 15 amperes to 600 amperes, up to 575 Volts. Made in 2 and 3 poles and for 3 and 4-wire systems. These devices are quick make and quick break with trip indication.

Multi-breaker Load Centers for controlling and protecting lighting and small power circuits. Made in a variety of circuit arrangements with capacities of 15, 20, 25, 35 and 50 amperes, for either 2 or 3-wire service, with individual trip.

Multi-breaker Load Centers in Cast Iron Enclosures for Class I, Group D and lower applications. Can be furnished for 2 and 3 wire solid neutral systems—up to 8 single pole circuits or combination of single and double pole. These cast enclosed Multi-breakers enjoy a wide variety of applications wherever explosive atmospheres exist.

• **Square D Circuit Breakers** provide quick restoration of service after short circuit or overloads. They eliminate fuses and reduce maintenance cost since no replacement of parts is necessary. • Built into every Square D circuit breaker is a time-lag feature which permits harmless momentary overloads to pass without causing the unit to disconnect the circuit. • Square D's line of circuit breakers is unusually complete, assuring the right unit for any given installation. • See our catalog in Sweet's or write for Industrial Circuit Breaker Bulletin. Address Square D Company, 6060 Rivard Street, Detroit 11, Michigan.





SQUARE D COMPANY

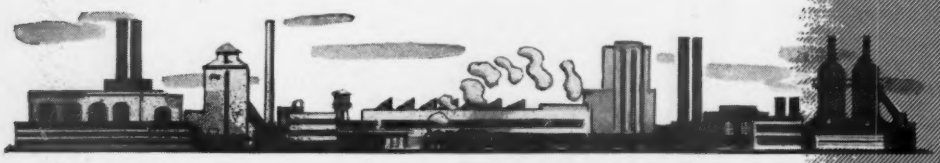
DETROIT • MILWAUKEE • LOS ANGELES

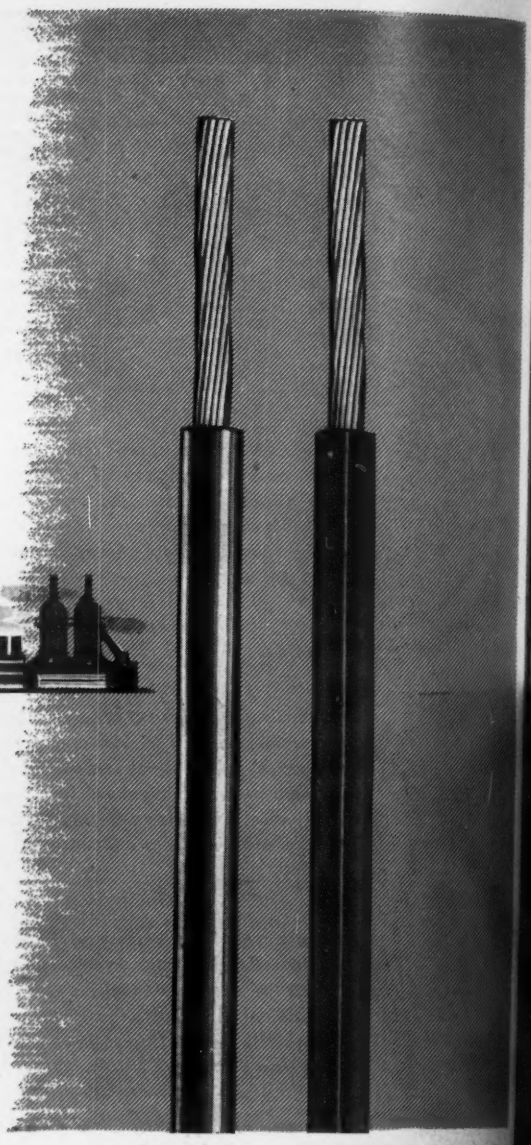
*Flamenol**

BUILDING WIRE

(SMALL DIAMETER)

- FOR COMPLETE WIRING SYSTEMS
- FOR RECONVERSION WIRING
- FOR WIRING EXTENSIONS
- FOR MAINTENANCE





Type SN for General Purpose Wiring

Type SNW for Wiring in Wet Locations

Here is a small diameter thermo-plastic insulated building wire that is sure to meet the requirements of any job you may be handling. It is available in two types in sizes 14 to 2,000,000 CM: Type SN for general purpose wiring; Type SNW for wiring in wet locations. Both types can be used for feeders, branch circuits or special wiring.

The insulations of both Type SN and Type SNW Flamenol wire have long life, are high in dielectric and mechanical strength and are resistant to oils, acids and alkalies. Type SNW Flamenol wire has a low moisture absorption rate. The small diameters of both wires enable more conductors to be used in conduits and ducts. Lubricated finish aids wire pulling.

*Reg. U.S. Pat. Off.

For Further Information on Flamenol Building Wire, G-E conduits or wiring devices, see your G-E Merchandise Distributor or write to Section CDW351-8, Appliance and Merchandise Department, General Electric Company, Bridgeport, Conn.

BUY WAR BONDS AND HOLD THEM

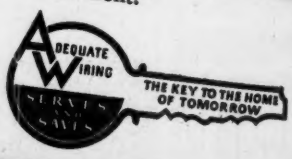
Hear the General Electric radio programs: "The G-E All Girl Orchestra" Sunday 10 P.M. EWT, NBC. "The World Today" news Mon. through Fri. 6:45 P.M. EWT, CBS. "The G-E House Party," Mon. through Fri. 4 p.m. EWT, CBS.

G-E CONDUITS AND WIRING DEVICES

General Electric also offers five conduits and a full line of wiring devices including: White and Black rigid conduits, EMT, flexible metal conduit, Fiberduct; and switches, fuses, lampholders, outlets, etc.

AIDS SOUNDNESS FOR LONG-TERM INVESTMENT

Victor W. Hartley, managing director of the Pacific Coast Electrical Association, Inc., Los Angeles, Calif. says on adequate wiring: "Wiring is a 'hidden value.' Upon its adequacy depends, in a substantial degree, not only the modern quality of the structure, but its soundness as a long-term investment."



GENERAL ELECTRIC